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BEFORE THE STATE WATER RESOURCES CONTROL BOARD
ON APPEAL FROM THE LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD

CALIFORNIANS FOR ALTERNATIVES TO TOXICS, a California non-profit corporation, WILDERNESS WATCH, a Montana non-profit corporation, THE FRIENDS OF SILVER KING CREEK, a California non-profit corporation, and LAUREL AMES and DR. ANN MCCAMPBELL, individuals,	**PETITION FOR REVIEW OF NPDES PERMIT ADOPTION; DECLARATION OF JULIA OLSON** Water Code § 13320
Petitioners,	*Hearing Requested* *Stay of Permit Requested*
v.	
LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD Respondent.	

INTRODUCTION

Pursuant to Water Code § 13320, Petitioners, Californians for Alternatives to Toxics ("CATs"), Wilderness Watch, the Friends of Silver King Creek, Laurel Ames and Dr. Ann McCampbell petition the State Water Quality Control Board to review and reverse the Lahontan Regional Water Quality Control Board's April 14, 2010 decision to grant NPDES Permit No. CA103209 to the California Department of Fish and Game for the Paiute Cutthroat Trout Restoration Project. (Ex. 18). This appeal is timely submitted within 30 days of the permit adoption. Petitioners have served copies of this petition and exhibits on the Lahontan Regional Water Quality Control Board and California Department of Fish and Game. Petitioners request that the State Board grant a stay of the NPDES Permit. (*See* attached Declaration of Julia A. Olson). Petitioners also request a hearing.

The Lahontan Regional Water Quality Control Board ("Lahontan Board") violated, among other laws, the Porter-Cologne Act, the Basin Plan and the anti-degradation provisions of the Clean Water Act when it issued the NPDES permit for the Paiute Cutthroat Trout Restoration Project in Silver King Creek ("poisoning project"). The Clean Water Act prohibits adoption of a permit that does not provide for compliance with the Clean Water Act, or regulations promulgated under the Clean Water Act. (40 C.F.R. § 122.4(a); see also 33 U.S.C. § 1342(b); Water Code § 13377.) The Porter-Cologne Act requires the regional water quality control boards to "establish such water quality objectives in water quality control plans as in its judgment will ensure the reasonable protection of beneficial uses and the prevention of nuisance." (Water Code § 13241.) "[A]ny activities and factors which may affect the quality of the waters of the state shall be regulated to attain the highest water quality which is reasonable…" (Water Code § 13000.) The Act requires that any waste discharge requirements, such as those in an NPDES Permit, be consistent with the applicable regional water quality control plan and in the public interest. (Water Code § 13269.) The Water Code prohibits issuance of a permit that is inconsistent with the requirements of the applicable Basin Plan. (Water Code §§ 13263(a), 13247.)

On March 31, 1995, the Lahontan Board adopted the Water Quality Control Plan for the Lahontan Basin. The highest water quality which is reasonable is set forth in the Basin Plan. The Basin Plan defines the beneficial uses of Silver King Creek to include among other things cold freshwater habitat; wildlife habitat; rare, threatened or endangered species; and spawning, reproduction and development. The Basin Plan specifically acknowledges that rotenone formulations and the detoxifying agent, potassium permanganate, "can violate water quality objectives and adversely affect beneficial uses of water." (Basin Plan, 4.9-24.) However, the Basin Plan allows for a temporary deterioration of water quality through the use of rotenone by California Department of Fish and Game ("CDFG"), in certain situations, and only if specific conditions are met and the project complies with the narrative and numerical water quality objectives for rotenone use.

The permit violates the Lahontan Basin Plan and Water Code because it: 1) fails to ensure that non-target aquatic populations, such as invertebrates and amphibians, that are reduced by the rotenone poisoning will repopulate the project area within one year; 2) fails to ensure that within two years of the last rotenone poisoning all applicable beneficial uses of the treated waters will be restored; 3) fails to comply with the antidegradation requirement in the Basin Plan; 4) fails to ensure that "[n]o chemical residues resulting from rotenone treatments shall exceed detection levels in ground water at any time." (Basin Plan, 3-10); 5) fails to ensure that no chemical residues resulting from the treatment will be present "at detectable levels within or downstream of project boundaries," such as within sediments (Basin Plan, 3-10); 6) fails to require a suitable monitoring program to ensure that beneficial uses fully recover after 2 years of project completion and to measure the effects of the project on surface, ground waters and sediments and 7) fails to provide monitoring adequate to assess whether or not pesticide label requirements for maximum application rates are met within the treatment area. With this NPDES permit for poisoning Silver King Creek, the Lahontan Board is attempting to rewrite the requirements of the Lahontan Basin Plan as it pertains to rotenone poisoning of streams and lakes. It may only do so through an approved amendment to the Basin Plan.

In addition, the Board should grant this appeal because as a CEQA Responsible Agency[1] and in violation of the Basin Plan, the Lahontan Board has failed to ensure that the EIR/EIS for this project complies with CEQA. The Basin Plan requires the Lahontan Board to have fully reviewed and understand the content and attest to the accuracy of the EIR. Yet there are many contradictions between information contained in the EIR and this permit in addition to false information. Further, Appellants have already filed suit in the Superior Court of Sacramento challenging the validity of the EIR. (Ex. 17). The Lahontan Board has not addressed any of these inaccuracies or illegalities that jeopardize the validity of the permit.

It is not in the public's interest for an NPDES Permit to be issued for a project with so many violations of law, and which, as the evidence shows, is not even necessary for the recovery of Paiute cutthroat trout ("Paiute CT"). Thus, the NPDES permit should be denied for the following additional reasons discussed in detail in this appeal: 1) Rotenone concentrations will be higher than in the 1991–93 poisoning; 2) there are application problems with CFT Legumine and omissions and contradictions in the NPDES permit; 3) past Basin Plan violations have not been enforced or accounted for in the EIR or permit; 4) the project is not necessary to protect the Paiute cutthroat trout; 5) no scientific evidence exists to indicate that Silver King Creek below Llewellyn Falls is the native habitat of the Paiute CT; and 6) it is not known if the series of falls at the lower end of Silver King Canyon are a barrier to

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[1] The NPDES permit states that "…the Water Board is…proceeding as a CEQA responsible agency (section 19, p. 17).

upstream fish migration, a critical question to the whether the poisoning would even succeed in its goal of permanently removing non-native fish.

In addition to all of these issues, the project is not a “recovery effort” as described in the NPDES permit. Despite the agencies’ rhetoric, it is an effort to establish a fishable population of Paiute CT and add it to the Heritage Trout Fishing contest. Non-native fish can be removed by mechanical species-specific means that do not harm other native species and disrupt aquatic and terrestrial food webs. The EIR/EIS analyzed non-chemical removal as a viable alternative. If the agencies had begun using mechanical removal of non-native fish eight or ten years ago, they would now have accomplished their goal. This permit is not critical to the Paiute CT. Paiute CT exist in many isolated and separate populations, at least five of which are in the Silver King Creek Basin at present and it does not face any imminent threat of extinction. The 2004 Revised Recovery Plan admits that because this is a small, isolated species it will always be vulnerable to stochastic events regardless of this project.

Appellants incorporate by reference all previous documents and letters in agency files on this project since it was first proposed in or about 2002. As more details of the project have been revealed with the preparation of, first, an Environmental Assessment and now a full EIR/EIS, the impacts are even greater than was first understood. Experts earlier suggested impacts to non-target species might be at least three or four years. But according to analysis of the data from the monitoring of the 1991-93 poisoning in Silver King Creek, impacts to the non-target invertebrate community lasted for at least six years from the time of the first poisoning and undoubtedly longer. Impacts were still clearly evident when monitoring ended.

Petitioners raised all of the issues presented herein to the Lahontan Board and presented as much information in support of this appeal as possible to the Lahontan Board in the form of comments and testimony. However, as discussed below, petitioners had less than one week from the time the EIR was issued until comments were due to the Lahontan Board. Thus, any information that may not have been presented relating to the EIR was a direct result of the Board's failure to delay the hearing and the limited amount of time for testimony they allowed of petitioners and petitioner's experts.

REQUEST FOR HEARING

Petitioners request a hearing to address the legal issues presented herein. Petitioners would also present testimony by Nancy Erman and Dr. Don Erman, experts on the scientific issues presented herein. Petitioners' arguments have not been fully heard or considered because of the short window for providing public comment on the proposed permit, once the final EIR/EIS was released, and because of the short time limit on public testimony at the Lahontan Board's hearing on this matter. Petitioners suffered the disadvantage of having to submit materials to the Board in advance of CDFG's submissions and were not able to review or respond to CDFG's late submissions, which petitioners viewed for the first time during the hearing.

BACKGROUND ON IMPACTS TO NON-TARGET SPECIES

The LRWQCB has known since at least 2002 (letter from N. A. Erman to Chair, LRWQCB, Sept. 10, 2002 (Ex. 1) and Erman, N.A. 2004, NPDES hearing evidence) that rotenone poisoning caused long-term impacts to invertebrate populations, to species diversity and abundances in Silver King Creek and in Silver Creek in the 1990s. The current NPDES permit uses the ambiguous term "temporary" changes (not defined) to invertebrates, rather than the definition of short (less than one year) and long-term changes ("greater than one year, up to five years," p. 9, NPDES permit) discussed in the Basin Plan. The permit concedes that the poisoning could result in the loss of species, of larger taxa (i.e., genus, family, order, which could include several/many species) and of species endemic to Silver King Creek. (NPDES permit, p. 18, (1)). It also states that "the proposed action will result in temporary changes in species composition in non-target aquatic invertebrate communities." (NPDES permit, p. 18

(2)). The last time rotenone was used in this basin it caused long-term changes to species composition of invertebrate communities. (Erman and Erman, 2006, in LRWQCB files (Ex.2) and letter from Harold Singer to FWS 2006 in LRWQCB files (Ex.3)). Therefore, there is no basis for assuming that changes next time will be "temporary."

The impacts to invertebrates lasted at least three years after the last poisoning in Silver King Creek and the poisoning was done for three years. The invertebrate populations and the food webs, both aquatic and terrestrial that depend on them, were impacted for at least six years and probably longer. The most abundant stonefly genus prior to poisoning was nearly gone three years following the last poisoning, providing evidence that though it was an abundant taxon in the basin, it was highly sensitive to rotenone. (Erman and Erman 2006 (Ex. 2)).

The NPDES permit states: "no macroinvertebrate species have been identified that are strictly endemic to the Silver King Creek Basin." In fact, no study of macroinvertebrates at the species level has been conducted. Adult specimens must be collected to identify species. The agencies have refused to do such an inventory, and the Lahontan Board has failed to require it.

In the same way, the agencies claim they have not found spring snails in the project area. But no sampling has been done in spring habitats. And contrary to the impression given in this permit, but according to the Final EIR, springs and seeps will be poisoned if they have a water connection to streams or are believed to have fish in them or to provide a refuge for fish during the poisoning.

Eleven macroinvertebrate taxa (families or genera) found in Silver King Creek between 1984 and 2006 are on the California Natural Diversity Database (CNDDB) Special Animals list. Fifteen species are listed on the CNDDB from those taxa. Until and unless adult specimens are collected and identified, it will not be known if these species occur in the Silver King Creek basin. The CNDDB is a computerized inventory of "the most rare animals, plants, and natural communities in California." It is kept by the Wildlife and Habitat Data Analysis Branch of the CDFG in collaboration with the Nature Conservancy and the Natural Heritage Network (Ex. 4).

In 2000 and in 2003, the California Department of Fish and Game (CDFG) denied that the 1991–93 poisoning had long-term impacts. (Trumbo et al. 2000 and an MOU between the Lahontan Board and CDFG, June 16, 2003). That assertion is repeated again in this permit, where it claims that impacts will be short-term, "yearly." (Permit, p. 8-9). But as of March 15, 2010, in a response to comments on the EIR/EIS, the U.S. Fish and Wildlife Service ("FWS"), the USDA Forest Service ("Forest Service"), and CDFG (collectively "the agencies") admitted that previous reports to the Lahontan Board were false: "The Agencies agree that Trumbo et al. (2000 a, b) found impacts on invertebrates three years following the 1993 Silver King Creek rotenone treatment and that impacts on invertebrates were still evident two years after the final Silver Creek rotenone treatment." (Final EIR/EIS, p. F-87, section 2-19 response to comments).

Monitoring was not required by the Lahontan Board beyond three years at Silver King Creek and two years at Silver Creek and so, the public has no way of knowing when or if these invertebrate populations and species ever recovered in all locations. Subsequent invertebrate monitoring studies conducted on Silver King Creek in 2003 to 2006 and in 2007 to the present are not suitable for answering questions about impacts from 1991 to 1996 for all of the reasons that were discussed in detail in expert comments to the EIR/EIS. (*See* Erman and Erman 2009, Ex 5). Further, these later studies were well beyond any reasonable definition of either short-term or temporary.

All studies being done as monitoring for impacts of poisoning are hampered by the failure and refusal of agencies to conduct species inventories of invertebrates present in streams, lakes, springs and seeps prior to poisoning.

The NPDES permit continues to repeat the incorrect assertion that springs and seeps, if not poisoned, can serve as macroinvertebrate refugia for post-project re-colonization. This issue has been refuted several times and most recently in Erman and Erman 2010a, (Ex 6), which was given to the Lahontan staff again prior to the hearing. Again, the misunderstanding about species and where they live is evident in the permit. Many species found in springs and seeps cannot live farther downstream in the watershed. (*See e.g.*, Erman 1989; Erman and Erman 1990, 1995). The agencies and the Lahontan Board have a confused understanding about the word "refuge" as it applies to springs. (*See* Erman and Erman 2010b). Springs and seeps will not provide protection to macroinvertebrates during poisoning.

Even the statements that springs and seeps will be protected are clearly untrue. According to the Final EIR, springs and seeps will be poisoned if they have a water connection to streams or are believed to have fish in them or are believed to provide a refuge for fish during the poisoning (Final EIR 3.2.2, p. 3-3; p. 3-8; 4.1.2 p. B-23; 3.2.2.1, p. 3-4; p. 6, Mitigation Monitoring/Reporting Program). Again, the statements in the NPDES permit give the illusion of protection to species and habitats, but are unfounded.

LEGAL ARGUMENT

I. The Permit Violates the Basin Plan's Requirement that Invertebrate, Amphibian and Other Aquatic Populations Repopulate the Project Area Within One Year.

The Basin Plan requires that "non-target aquatic populations (e.g., invertebrates, amphibians) that are reduced by rotenone treatments are expected to repopulate project areas within one year" of treatment. (Basin Plan, 3-12.) In 2005, the Lahontan Board declined to issue a similar NPDES permit for nearly the identical project because it did not have enough monitoring data from CDFG to demonstrate that non-target aquatic populations of species would repopulate the project area within one year, in compliance with the Basin Plan. In fact, the Lahontan Board found that existing studies did not agree with CDFG's claims that this water quality standard would be met.

The EIR/EIS, supporting data and studies and expert analyses now confirm that non-target aquatic populations will not repopulate the project area within one year of project completion.

> The impacts to invertebrates lasted at least three years after the last poisoning in Silver King Creek and the poisoning was done for three years. The invertebrate populations and the food webs, both aquatic and terrestrial, that depend on them were impacted for at least six years and probably longer. The most abundant stonefly genus prior to poisoning was nearly gone three years following the last poisoning, providing evidence that though it was an abundant taxon in the basin, it was highly sensitive to rotenone.

(Erman and Erman 2010). CDFG had previously denied these impacts, but in March, 2010, CDFG admitted for the first time that its prior reports to the Lahontan Board were false and that the Erman's analysis was accurate. The EIR admits that potentially significant and unavoidable impacts of the project include the loss of benthic macroinvertebrate taxa, including unidentified rare and endemic species to Silver King Creek.

Because the agencies have still failed to conduct any species level monitoring of aquatic invertebrates in the stream system, the loss of populations of whole taxa could correspond to unknown numbers of species.[2] Thus, the broad taxa monitoring does not answer the question of what and how many species will be lost by this poisoning project. Nonetheless, it is clear that non-target aquatic populations affected by rotenone will not repopulate the project area within one year of project completion as required by the Basin Plan.[3]

II. <u>The Permit Violates the Basin Plan's Requirement that Existing Beneficial Uses Be Restored Within Two Years</u>.

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[2] It is possible to collect adult invertebrate forms and make a pre-project inventory of aquatic macroinvertebrate species and could have been accomplished by now during the last eight or ten years the agencies have been planning this poisoning project.

[3] In order to adopt this NPDES Permit, the Lahontan Board was required to find that within one year post-treatment, aquatic populations affected by rotenone would recover. It is not enough to claim that some suite of aquatic invertebrates will repopulate the stream. It is the assemblage of invertebrates that existed pre-poisoning that must repopulate the stream.

Rotenone applications are only justified, under the Basin Plan, if they cause only short-term impairment of beneficial uses. The Basin Plan does not allow for rotenone projects to outweigh protection of existing beneficial uses where beneficial uses suffer anything but temporary impairment. (Basin Plan 4.9-23).

Specifically, the Basin Plan requires that, within two years of the last treatment for a specific project, a qualified CDFG biologist or specialist certify in writing that the existing beneficial uses of the treated waters have been restored. (Basin Plan, 4.9-25.) By requiring that the monitoring report, confirming that beneficial uses have been restored, is completed within two years, this Basin Plan provision complements the one stated above that non-target aquatic populations repopulate within one year of treatment. As noted, the existing beneficial uses of the Lahontan basin include among other things (1) cold freshwater habitat and (2) rare, threatened, and endangered species. The permit violates this standard on similar bases that it violates the standard requiring existing non-target aquatic populations to repopulate the area within one year. The permit allows CDFG to extirpate or reduce any rare, endemic, or ecologically significant macroinvertebrates from the stream system, and since the additional studies have not been performed to determine the identity of aquatic invertebrate species, there is no substantial evidence that beneficial uses of the system will be restored within two years of the last poisoning with rotenone. Again, because information and data to ensure compliance with specific water quality standards is indisputably missing, and data are feasible to obtain through methodologies recommended in the past by the Lahontan Board, the Lahontan Board's decision violates the Basin Plan.

Indeed, the EIR/EIS and the permit (p.18) now concede that a potential significant impact of the poisoning project is the permanent loss of rare and endemic aquatic invertebrate species to Silver King Creek. If species are lost, the changes are permanent and far longer than "five years." Eleven macroinvertebrate taxa (families or genera) found in Silver King Creek between 1984 and 2006 are on the California Natural Diversity Database (CNDDB) Special Animals list. Fifteen species are listed on the CNDDB from those taxa.

The Lahontan Board does not explain the contradictory statements in the permit that on the one hand the project could result in the loss of entire rare and endemic macroinvertebrate taxa (p.18) and on the other hand there will be no significant long-term impacts (greater than one year) to macroinvertebrates (p.8-9). Further, the evidence on which the Lahontan Board relies for its claim of no long-term impact has been rescinded by the agencies in the Final EIR/EIS in response to public comments.

The Lahontan Board's and CDFG's past track record also indicates that the Basin Plan will be violated. For instance, the Basin Plan's two-year reporting requirement to ensure that beneficial uses were protected was not enforced by the Lahontan Board in 1998 for the prior stream-poisoning project in the Silver King Creek watershed. CDFG did not complete its report on invertebrates until 2000, and the data on which those reports were based showed that beneficial uses had not been protected or restored. (Trumbo et al., 2000).

By issuing this permit, the Lahontan Board is now claiming, in essence, that it does not matter what invertebrate species return to a stream after poisoning as long as some invertebrates return. In verbal testimony, Bruce Warden, staff member in charge of this project, stated, "[n]ote that restoration of beneficial uses of water does not mean complete restoration of pre-project conditions. It means that project area water quality and associated ecosystems are capable of functioning in a manner that is adequately supportive of beneficial uses." (Lahontan Board Hearing, April 14, 2010). "Beneficial uses" is not defined in this statement and "adequately" is open to almost any interpretation. Mr. Warden's interpretation is contrary to more precise wording in the Basin Plan and the Clean Water Act. All water, almost without regard to degree of pollution, will support some kind of invertebrate life.[4] The quality of that life, i.e., what species are present, is critical. Therefore, this new interpretation by Lahontan staff undermines the meaning of the Basin Plan and the Clean Water Act and does not protect the existing beneficial uses of the stream. It also runs contrary to the Basin Plan's expectation that non-target aquatic populations of invertebrates and amphibians would repopulate the area within one year.

III. The Permit Violates the Antidegradation Requirements of the Basin Plan and the Clean Water Act.

The Clean Water Act and its implementing regulations include an "antidegradation policy" to protect water quality and beneficial uses. The policy provides that "[e]xisting instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected." (40 C.F.R. § 131.12(a)(1).) Even where water quality may be appropriately lowered, water quality must still be "adequate to protect existing uses fully." (40 C.F.R. § 131.12(a)(2).) The State of California's antidegradation policy, State Board Resolution No. 68-16, is a requirement of the Basin Plan. It provides that "in no case may such increases [of pollutant levels] cause adverse impacts to existing or probable future beneficial uses of waters of the State." (Basin Plan, 3-14.) To protect instream uses from degradation, the Basin Plan provides that "[r]eductions in water quality should not be permitted if the change in water quality would *seriously harm any species* found in the water (other than an aberrational species)." (Basin Plan, 3-14, emphasis added). For potential "Outstanding National Resource Waters," such as this wilderness stream system, there may be no permanent or long-term reduction in water quality. (*Id.*) Even where the state has not formally designated a waterbody as an ONRW, the Basin Plan provides that waters of exceptional recreational and/or ecological significance

[4] This is the equivalent of arguing that as long as some vegetation grows back in a clearcut and herbicided forest, it can still be used as a forest, even if what grows back in the place of native vegetation are invasive weeds.

receive the special protection of ONRW waters and thus, their water quality may not be lowered. (Basin Plan, 3-14-3-15.)

The Lahontan Board cannot find that the change in water quality would *not* seriously harm any species found in the water (other than aberrational species). (*See* Permit, p.18, detailing potential loss of entire rare and endemic species). In other words, even assuming that the antidegradation policy allows a temporary reduction in water quality and short-term impairment of beneficial uses, it does not allow a reduction in water quality if the result is serious harm to any species. Eliminating populations for at least six years and potentially extirpating rare and endemic species from the stream system constitutes serious harm to species. In this respect, the Lahontan Board failed to consider and resolve all requirements of the antidegradation policy when it decided to issue the permit.

The Lahontan Board's reliance on monitoring to prevent degradation of species composition is misplaced given that no species level monitoring of invertebrates has been conducted, or will be conducted before the poisoning, and monitoring after the fact will not reduce the level of impacts, it will only report them. As has been reported from prior poisoning projects, the impacts will be severe and long-term and degrade water quality for beneficial uses.

In addition, any claim that untreated seeps and springs could act as refugia for invertebrates is unsupported by evidence. Erman and Erman have detailed the limited range of many headwater invertebrate species. Further, it defies logic to think that invertebrates living in the stream will know to take refuge in the seeps and springs while 11 miles of stream are poisoned. There is no credible evidence supporting the Lahontan Board's position that this is adequate mitigation.

IV. <u>The Permit Does Not Adequately Address the Basin Plan's Requirement of No-detect Levels for Ground Water</u>.

The Lahontan Board must ensure that "[n]o chemical residues resulting from rotenone treatments shall exceed detection levels in ground water at any time." (Basin Plan, 3-10). However, the permit and monitoring plan do not provide any mechanism for ensuring and monitoring that chemical residues do not enter ground water.

V. The Permit Violates the Basin Plans Requirement to Prevent Detectable Chemical Residues in Sediments.

The Lahontan Board fails to ensure that no chemical residues resulting from the treatment will be present "at detectable levels within or downstream of project boundaries," such as within sediments. (Basin Plan, 3-10). The permit and monitoring plan do not address contamination of sediments. However, the recent Lake Davis poisoning has demonstrated that sediments can be contaminated with rotenone and release those chemicals into surface waters. (Ex. 6). Hyporheic invertebrate life will be affected by the residual rotenone in the substrate. (Erman and Erman 2010).

VI. The Permit Violates the Basin Plan's Requirement of a Suitable Monitoring Program.

The Lahontan Board was required to develop a monitoring program, which would ensure that beneficial uses fully recover after 2 years of project completion and to monitor the effects of the project on surface, ground waters and sediments. The permit claims that the monitoring program need only address surface water and that ground water and sediments need not be monitored because "no water intakes exist within or near the project area." (Permit, p. 15).

The Lahontan Board is wrong for two reasons. First, the monitoring requirement for ground water and sediments is not linked to the potable drinking water provision of the Basin Plan. It is an independent requirement. Second, contamination of ground water and sediments is highly relevant to the effect of the project on beneficial uses, including aquatic invertebrates.

When the Regional Board adopted Resolution No. 6-90-43 to allow conditional use of rotenone by CDFG, it imposed conditions, which became elements of the Basin Plan. The conditions, given in Chap. 4.9, p. 25-26, state: "A variance will not be granted for any project that fails to meet these conditions." In other words, permitting the use of rotenone must meet all the conditions as part of the Basin Plan.

VII. The EIR Supporting the Permit is Inadequate and Illegal

Before the Lahontan Board may issue an NPDES Permit to CDFG, it must first determine that CDFG has satisfied the requirements of CEQA. The permit states that CDFG has provided an adequate certified EIR. However, the EIR is illegal for numerous reasons and the Lahontan Board seemed unfamiliar with the EIR and some of its findings and disclosures. The Lahontan Board, as a responsible agency under CEQA and pursuant to the Basin Plan, must review the EIR and ensure that it is in compliance with law. For many of the reasons discussed below and outlined in the petition for writ of mandate filed by petitioners in Sacramento Superior Court (Ex.17), the EIR is invalid.

A. Rotenone concentrations will be higher than in the 1991–93 poisoning.

The current project in Silver King Creek proposes to apply rotenone at approximately 2 to 4.6 times the mean concentration that was measured in the 1991 to 1993 poisoning of the upper parts of Silver King Creek above Llewellyn Falls. Rotenone was measured at a mean concentration of 10.8 µg/L for the six poisonings of Silver King Creek in 1991–93 (Table 1, Trumbo et al. 2000a and Flint et al. 1998) and will be applied at concentrations from 25 µg/L to 50 µg/L in the proposed project (target concentration of 0.5 to 1.0 mg/L CFT Legumine.) (Final EIR).

At these concentrations, rotenone (CFT Legumine) can be expected to have at minimum the same or greater impacts on non-target species than the previous poisonings had. The FEIR/EIS admits the following in response to comments: "Thus the statement of using lower rotenone concentration than have been used in the past on page 5.3-11 [of the DEIR] was a misstatement and has been corrected." (Final EIR, p. F-95).

Despite this significant error in the DEIR/EIS about the amount of rotenone to be used in these waterbodies, the Final EIR/EIS does not reevaluate potential impacts based on these corrected concentrations. Further, during the Lahontan Board's hearing, board members and staff seem surprised to learn that the rotenone concentrations would in fact be greater with the new proposed formulation (CFT Legumine). This information has not been evaluated by CDFG or the Board in the EIR or permit.

B. Problems with CFT Legumine and Omissions and Contradictions in NPDES permit.

1. No analysis of cube resins

In 1991 –1993, CDFG poisoned Silver King Creek above Llewellyn Falls with the rotenone formulation, Nusyn-Noxfish, a formula of rotenone with active ingredients of 2.5% rotenone, 2.5% other cube resins, and 2.5% piperonyl butoxide. They proposed to use the same formulation again in 2002, 2004 and 2009 (Draft EIR/EIS). The agencies have purportedly abandoned that formulation, apparently because of high environmental risk.

In the current project, the agencies plan to use CFT Legumine, which has 5% rotenone and 5% other cube resins as active ingredients. (Ex. 7). Bruce Warden, revealed in public testimony at the April 14, 2010 hearing that cube resins have not been and will not be monitored in the water. When questioned, Mr. Warden stated that he did not know whether or not the other cube resins would be neutralized by potassium permanganate. Neither the final NPDES permit nor the final EIR/EIS discloses or analyzes potential impacts from cube resins (which may include such toxic substances as deguelin and tephrosin).[5] Cube resins are not included in Table 1 of the permit. Breakdown of deguelin and tephrosin, unlike rotenone, does not produce rotenolone. (Caboni et al. 2004). Therefore, monitoring of either rotenone or rotenolone will not account for other cube resins in the active

[5] Adding up the percentages of ingredients in CFT Legumine, disclosed in the EIR, totals only 95%, leaving out the 5% active ingredient(s) of cube resins. (DEIR, App. B, Sec. 2.1.3, p. B-7). Cube resins are left off the Table that gives ingredients for all three possible rotenone formulations in the DEIR. (Table 5.3-1 in Chapt. 5).

ingredients. Deguelin also has been shown in laboratory tests to elicit the same Parkinson's Disease-like changes in cells as rotenone. (Caboni et al. 2004).

In other words, half of the active ingredients in CFT Legumine have not been analyzed or considered in this permit or the EIR. (Erman and Erman 2010b) (Ex. 8).

2. CDFG cannot successfully manage CFT Legumine at target rotenone levels.

CFT Legumine was recently used (2007) in the second poisoning of Lake Davis and in all streams, springs and seeps in the Lake Davis watershed that feed the reservoir. Erman and Erman supplied an analysis to the Lahontan Board on the results of that major poisoning. (Exhibit 6). Their analyses were based on the information given in McMillan and Finlayson 2008. To summarize, the CDFG was unable to apply the rotenone in CFT Legumine at target levels. Levels were far above the target levels (> 1000% above target levels at some stations in the first poisoning), and high concentrations were even more common in the second poisoning than in the first. (Fig. 1, Ex. 6 and Ex. 8). These results indicate the inability of CDFG to deliver, under field conditions, the poison rotenone in CFT Legumine at designed concentrations. Based on the Lake Davis watershed results, we think it highly likely that CDFG will exceed the EPA/FIFRA label requirement of 50µg/L in Silver King Creek if this project is allowed. These real application risks have not been analyzed, disclosed and accounted for in either the EIR or the permit.

3. Rotenone persisted after 2007 Lake Davis treatment with CFT Legumine.

Rotenone persisted in the bottom sediments of Lake Davis for at least six months. Rotenone was measured in stream water 14 days after it had been applied. It had apparently persisted in bottom sediments and was being released back into the stream. These results indicate that CFT Legumine behaves in some unexplained and unknown ways. It is unknown if rotenone persisted in streams longer than this measured period. Monitoring was apparently not conducted beyond two weeks in streams. (Ex. 6). This relevant information is not disclosed or analyzed in the permit or the EIR/EIS.

4. <u>The Permit and EIR are inconsistent about timing and formulations to be used.</u>

Under #8 in the permit, the Lahontan Board describes a project that will apply rotenone once a year for three years. But in the Final EIR, a project of applying rotenone poison twice a year for three years is described. (Draft and Final EIR, p. 3-9 and App. F, p. F-38). The NPDES permit makes no rule about how many times a year rotenone can be applied.

Wording in #8 indicates that the discharger will only use CFT Legumine. But #10 of the permit references "…one or both proposed rotenone formulations…" And the Final EIR makes references to using the formulation Noxfish as well as CFT Legumine. (Final EIR, Response 1-50, p. F-50). The NPDES permit has not analyzed Noxfish.

5. <u>Gel and sand matrices as forms of treatment are not analyzed.</u>

The current NPDES permit states that "gel or sand matrices may be used on small seeps." (Permit, p. 6). Gel or sand matrices for use in springs and seeps were excluded in the NPDES permit when it was presented to the Lahontan Board in 2004 because of concerns about calibrating dosage. Gel or sand matrices are not specified by the EPA as being an approved method of application of rotenone. The CFT Legumine label does not include application by gel packs. Neither the EIR nor the permit discloses or evaluates the impacts of gel or sand matrices and neutralization capabilities.

6. <u>Rotenone withdrawn for terrestrial use and banned for marine and estuarine use</u>

The following statement found in the permit is false: "In addition, this formulation [CFT Legumine] has been shown not to have adverse human health concerns." No citation is given for the source of this misinformation. It did not come from the product label (Ex. 7) or from the Environmental Protection Agency ("EPA").

In addition, the DEIR incorrectly claimed that "because of rotenone's natural origin, toxicity to pest organisms, relatively low toxicity to birds and mammals, rapid detoxification in warm water, and low environmental persistence has made it a popular and effective organic pest management tool. It is used by gardeners, for lice and tick control on pets, and for fishery management (USEPA 2006). In the United States, rotenone is classified as a General Use Pesticide (GUP), although uses on cranberries and for fish control are restricted (Extoxnet 1996)." (Appendix C.3.1, p. C-11).

Information on the dangers of rotenone has evolved significantly in the last few years. The EPA conducted a review of rotenone in 2006. Subsequently, the manufacturers of rotenone withdrew it for all terrestrial use (insect and/or invertebrate control) in the U.S., Canada, and the European Union. The EPA asked the companies that produce rotenone to submit evidence on the neurotoxic effects of rotenone on humans. The companies chose to withdraw from the market the products containing rotenone rather than supply the data. (EPA website: www.epa.gov/oppsrrd1/reregistration/rotenone Docket ID: EPA-HQ-OPP-2005-0494). Many studies over the past 10 years have shown a connection between rotenone and Parkinson's disease.

In 2009, the EPA banned rotenone for use in marine and estuarine habitats.

The only use of rotenone now is as a freshwater poison to kill unwanted fish. It is a non-specific poison that also kills aquatic insects, other aquatic invertebrates, and amphibians at the same time it kills fish. As a consequence, rotenone poisoning disrupts aquatic and terrestrial food webs for many years and affects many other species. These effects have been acknowledged by the EPA. (Ex. 5).

The blatant inaccuracies about the accepted and approved uses and safety of rotenone in both the EIR and the permit, give the public a very false sense of the actual impacts of this piscicide. In fact, this poison is highly dangerous and is no longer approved for all but one use.

C. <u>Past Basin Plan violations have not been enforced or accounted for in the EIR or permit.</u>

Once poison has been applied to water, monitoring of either the poison or the animal life, no matter how thorough, cannot change the impacts of the poison, of the mistakes that were made, of information that was not known, revealed, or understood, or of species that were lost. The Lahontan Board has permitted many of these poisoning projects in the past. And many mistakes have occurred during these poisonings in the Lahontan region. Violations that occurred in the Lahontan Region between 1988 and 1993 have been documented from LRWQCB files. (See e.g., Erman and Erman, 2005, Ex. 9). The long-term impacts to non-target species were a violation of Lahontan Basin Plan standards. Impacts to invertebrate populations and to species diversity were evident in 1996, three years following the last poisoning of the stream in 1993.

As far as the record shows, the Lahontan Board has not held CDFG responsible for any past violations that occurred during rotenone poisoning, not even for misrepresenting the data that were required after the last poisoning of Silver King Creek. There is no evidence in the EIR or permit that these past violations are being considered in evaluating the likelihood of project compliance with the Basin Plan in the future. The Lahontan Board is behaving as if it is a partner in this proposed project, and not as a regulatory agency.

D. <u>There is no need for the project.</u>

The Paiute cutthroat trout currently is stable or expanding in populations in 10 separate streams in 5 separate basins. (U.S. Fish and Wildlife Service 2004). Either five or six separate populations of Paiute CT, isolated by barriers, exist in the Silver King basin alone. In arguing the need for this project, the Lahontan Board has found that additional habitat is needed in order to secure the Paiute cutthroat trout from stochastic events or invasion by non-native fish that may compete or interbreed with it. (Permit, p.1-2).

The NPDES permit and the EIR present findings that the project will improve the population of PCT by "reducing threats from genetic bottlenecking," by "connecting with other populations within the Silver King Watershed" and by "the enhancement of genetic diversity of the Paiute cutthroat trout." (Permit p. 20). The proposed project will do little or nothing to remove genetic bottlenecks in the populations of Paiute CT.

There is no evidence presented in the Final EIR of any plan or analysis that shows how creating one more population of Paiute cutthroat trout will or can remove the existing genetic bottlenecks in the fish. These bottlenecked conditions and limited genetic diversity are already in place. This condition would be expected for a population founded on a small number of individuals and through subsequent bottlenecking created from random genetic drift and the significant selective pressure caused by the agencies removing spotted fish and isolating transplants. (Ex 8).

Cordes et al., 2004, who did recent genetic work on the Paiute CT, stated that genetic bottlenecking "has almost certainly been exacerbated by the repeated chemical treatment and restocking of virtually all of the extant populations." (Cordes et al. 2004, p.116). Cordes et al. showed that in the nine separate populations they genetically tested, all but two (Fly Valley Creek and Coyote Valley Creek) are significantly different genetically from each other. Some populations have alleles that others do not have, some populations are missing alleles that are found in most or all other populations, and nearly all populations have significantly different frequencies of alleles. (Tables 3 and 4, Cordes et al. 2004, Ex. 10). Merely stocking one more population below Llewellyn Falls that is disconnected from all other extant populations has no prospect of reducing genetic bottlenecks or enhancing genetic diversity.

In the first genetic consultant's report to the agencies in 2002 (Israel et al. 2002, p. 12), and in the subsequent publication (Cordes et al. 2004) the authors recommended, "[a]dditionally, the development of molecular markers that can distinguish between LCT and PCT would be important for determining their genetic relationship and investigating the possibility of introgressive hybridization between the two groups <u>prior to any restorations.</u>" (Cordes et al. 2004, p. 116, emphasis added).

The agencies have been selectively manipulating these fish for many years, at least through 1993, by manual removal of "heavily" spotted fish (those with five or more spots, Ryan and Nicola 1976, Flint et al. 1998, Moyle 2002). As a consequence, the genetic make up of the residual population has been further compromised through artificial genetic selection. (Ex 8).

To date, there has been no attempt to examine whether the specimens of Paiute CT preserved in the California Academy of Sciences could be examined for comparison with existing populations in order to form a genetic baseline.

Restocking would come from Fly Valley Creek, Four Mile Canyon Creek, upper Silver King Creek and possibly Coyote Valley Creek (EIR p. 1-3, 2-1, 2-4) but only streams with pure populations within the watershed. (EIR p. C-2). Ignoring the out-of-basin populations guarantees that some of the genetic variation, distinct alleles represented only in those populations, will not be included in the new location.

The agencies claim that the total number of adult Paiute CT in the entire Silver King Creek basin is 1020. (Final EIR). Included in this count are the fish in Fly Valley, Four Mile, and Silver King creeks (790 adult fish) and a further 100 in Coyote Valley Creek. This total cannot all be used in stocking elsewhere, and whatever the number, they are to be distributed over 6 miles of Silver King Creek below Llewellyn Falls and 5 miles of tributary streams. The Final EIR states that 30 – 150 fish of three age classes, including 75% sub-adults, will be restocked from donor streams. (Attachment A, p. 7 – 8). Therefore, the stage is set for stocking a small number of fish into the new habitat, and once again creating the conditions of accelerated random genetic drift and further bottlenecking—exactly the opposite of what the Lahontan Board has found as justifying the project. If higher numbers of PCT are stocked, the populations at donor sites are placed at risk of extinction or further loss in genetic diversity from random genetic drift. (Ex. 8).

E. <u>No proof of a barrier falls at the bottom of Silver King Creek canyon</u>

This entire project, claims made in the Revised Recovery Plan and the issuance of this permit depend entirely on the efficacy of a downstream barrier to upward fish migration. Without such a barrier, this project is pointless. The question of whether there might be an impassable fish barrier downstream of Llewellyn Falls was raised for the first time in a 1976 report suggesting a survey be conducted of the canyon for barriers to upstream fish movement to more accurately determine the relationship between Lahontan cutthroat trout and PCT and historic habitat. (Ryan and Nicola, 1976). Yet, in the last 34 years, the agencies have failed to make the measurements recommended for proving or disproving that a barrier to fish migration exists under all flow conditions for all non-native fish. (Erman and Erman 2009, Ex. 5). The agencies have only completed two rudimentary low-flow studies of the alleged impassable barrier and both studies concluded that they could not state definitively that the barrier was impassable at high water levels. Yet, the need for and result of an entire wilderness poisoning project hinges on that uncertainty. The Board should, at minimum, require a definitive answer to the question of fish passability at all flow levels, under all conditions, before authorizing degradation of water quality and violations of the Basin Plan. Rotenone use should not be permitted if it is not certain to achieve the result intended.

The evidence available indicates that it is possible for fish to swim upstream of the barrier. Rainbow trout and Lahontan cutthroat trout migrate far upstream during spawning season during high water flows in the spring. A photograph submitted in the EIR as proof of a 10-foot falls, under low flows, also shows a second passage around the falls that is step-like and may likely allow fish passage under high water conditions. (Ex. 11). This "highest barrier" is described as a falls that "drops approximately 10 feet vertically on the left side of the main boulder and cascades through a tightly spaced series of smaller drops around the right side of the boulder over a distance of 20 or 30 feet." (USDA Forest Service EA 2004, p. 76). Notably, one of the "studies" on the alleged barrier also attached an analysis of cost for building an impassable barrier on Silver King Creek. Thus, the agencies fully understand the uncertainty and risk and have investigated the back-up option of building a barrier, which would be illegal in wilderness.

In discussing the many failures made by CDFG in efforts to re-stock golden trout in the Golden Trout Wilderness Area, Phil Pister, retired fish biologist with CDFG wrote: "CDFG had for many years planted catchable rainbow trout there to satisfy roadside anglers, under a naive assumption that insurmountable natural barriers would prevent them from reaching golden trout country. Completely insurmountable barriers are very rare within natural stream systems." (Pister 2008).

The Final EIR has included information on leaping distances of 14-inch rainbow trout to imply that no fish could get over the falls. But private fish hatcheries, certified by CDFG, sell fish to Alpine County which then introduces fish into public waters of the East Fork Carson River. (Peter Ottesen at www.recordnet.com). One of the strains of fish developed by one of these hatcheries, the "Alpers" rainbow trout, reaches sizes as large as 20 inches and includes genetic material from steelhead salmon (Press Interview with Tim Alpers, Daily News, Los Angeles, CA, Sept. 22, 2002; http://www.thefreelibrary.com/ALPERS' ALCHEMY FISH FARMER CLOSES IN ON DESIGNING NEAR-PERFECT TROUT...-a092172642); Wild trout up to 20 inches in length are now caught in the East Carson River. (Ex. 12, Ecoangler.com).

If large fish can and have moved upstream into the Silver King Creek canyon in the past, then the reach now to be poisoned was the native habitat of the Lahontan CT, not the Paiute CT.

F. <u>The Myth of the Historic range of Paiute CT</u>

The NPDES permit justifies poisoning these streams with the claim that the areas to be poisoned are the historic range of the Paiute CT (p. 2, Project Purpose), but scientific evidence does not exist that Paiute CT is the native trout below Llewellyn Falls. As discussed above, the stretch of creek below Llewllyn Falls would only have been Paiute CT habitat if there was an impassable fish barrier. The evidence is inconclusive about the efficacy of that barrier, but there is sufficient evidence to suggest that it is not impassable at high water flows.

The agencies persist in creating the impression of data and science where there is none. They repeat citations in literature in support of their claim for the historic range of Paiute cutthroat below Llewellyn Falls:

> The historical range has been documented in numerous scientific documents (Behnke and Zarn 1976, Ryan and Nicola 1976, Busack 1975, Behnke 1979, Behnke 1992, Moyle 2002). The original specimen (the "type specimen" or "holotype") of Paiute cutthroat trout was collected by Snyder (1933) outside of the historical range described above. Behnke (1992) clarifies the discrepancy between the collection location (type locality) and the historical range…"

(FEIS, Master Response C, p. F-3). All of these references trace back to the same, singular, identical source: the letter from Virgil S. Connell, a sheep rancher, in 1944 to CDFG biologist Curtis (reproduced in Ryan and Nicola 1976). In that letter, Mr. Connell only claimed that he and his friend did not catch any fish above Llewellyn Falls. He also grossly exaggerated how many fish they caught in 2.5 days of fishing below the falls. Thus, a reasonable interpretation of his recollection 54 years after the events might just as well be that he did not catch <u>many</u> fish compared to the catch below the falls. He also, despite creative editorial interpretation by the USFWS (2004) of "spotted fish," did not identify <u>any</u> fish from Silver King Creek. His only descriptive terms were "fish" and "mixed with different kinds" or "varieties." What species he saw or caught remain a mystery. There is no evidence that Mr. Connell was qualified to identify these fish. The agencies know these facts. Just as they know that in Snyder's

(1933) original description of the Paiute cutthroat he mistakenly claimed it was a spotless form of the Lahontan cutthroat. (Ryan and Nicola 1976). Yet, the Lahontan Board, an agency charged with ensuring the validity of the EIR and the need for the poisoning project, continues to perpetuate these unsupported claims. There is only one substantiated scientific finding for the "historic range" of the Paiute cutthroat—Snyder's (1933) original collection of PCT above Llewellyn Falls. The Revised Recovery Plan (FWS 2004) eventually acknowledged that the native habitat of the Paiute CT is a matter of conjecture (p. 15).

The agencies' reliance on references to Mr. Connell's herder (Joe Juanseras) as the one who transplanted Paiute CT above Llewellyn Falls is even more bizarre: no one other than Mr. Connell ever spoke to Mr. Juanseras and Mr. Connell's account of Mr. Juanseras' transplants was written 32 years after the supposed transplant of unidentified fish occurred. Thus, Mr. Connell's account of transplants above the falls is nothing more than hearsay. Another report (Ashley 1970), which is discounted by the agencies, claimed that Mr. Juanseras' brother reported that the original 1912 plant above the Llewellyn Falls was a failure and success did not occur until 1924. (Ryan and Nicola 1976). These hearsay accounts of what sheep herders did more than 30 years after the events purportedly occurred, without any corroborating evidence and without any identification of the fish being transplanted, does not form a scientific basis for establishing the true "historical range" of the Paiute cutthroat trout below Llewellyn Falls, no matter how many times or where they are repeated.

G. <u>Fish Stocking by the Agencies in Silver King Creek and East Fork Carson River</u>

Another reason for the project, stated in the NPDES permit, is that the agencies are concerned that non-native fish will be introduced by humans above Llewellyn Falls where the Paiute CT has been re-established. The same thing could happen with the new population of Paiute CT that the agencies want to establish. And as discussed above, there are five separate populations of Paiute CT already in the basin.

The greatest threat of non-native introductions has come from the agencies themselves. (Ex. 8). From 1930 through 1991 more than 200,000 fish representing six species, subspecies or hybrids have been introduced into the Silver King Creek basin on at least 92 separate occasions. (EIR, Tables 5.1-2, 5.1-3). The most recent intentional introduction by the agencies took place in 1991, the same year they began poisoning the upper Silver King Creek basin again. At that time fish were introduced into Tamarack Lake. The list above only includes recorded stocking events, but does not count what the agencies call “inadvertent” introductions like the one that occurred in 1955 or 1956 when Lahontan CT were dropped by air into Whitecliff lake by a CDFG plane. (Ryan and Nicola 1976). The authors speculated that the pilot could not tell the difference from the air between Whitecliff Lake and Tamarack Lake, the intended target.

At various times, fishing has been allowed and promoted in the Silver King Creek basin above the canyon. Most recently, CDFG requested and received permission from the Fish and Game Commission to increase the take limit from 5 to 10 fish in Silver King Creek to promote harvest.

In 2008, CDFG invited selected individuals to accompany CDFG personnel on a private fishing trip to Silver King Creek to fish for Paiute CT in the closed reaches above Llewellyn Falls. (Ex. 13)

CDFG continues to advertise and promote the Heritage Trout Program that includes the Paiute CT in the list of species. (Ex. 13). The program leader of the Wild Trout Program and the Heritage Trout Program (David Lentz) is a co-author of the report (Deinstadt et al. 2004) that stated, “[t]he planned addition of a catch-and-release Paiute cutthroat trout fishery below Llewellyn Falls, which is conditioned on removal of the existing trout population, will provide a unique opportunity.” The agencies have been promoting fishing for the new population of Paiute CT that they hope to establish with this poisoning.

It is not a requirement of the Endangered Species Act that a species must exist in high enough numbers to harvest in order to remove it from the list of threatened species. A conflict of interest exists when the agencies that want to establish a new sport fishery are the same agencies that control the de-listing of the fish as "threatened."

Fishing is allowed and promoted in the wild trout reach of the East Carson River up to the Carson Falls (a Trialside Wild Trout Stream). Immediately above the falls, fishing is closed to protect an isolated population of Lahontan cutthroat trout. "This population is one of the few remaining composed of original Carson River strain fish." (Deinstadt et al. 2004, Ex 14). Fishing immediately below this isolated population of Lahontan CT is not seen as a threat by the agencies. Yet, in Silver King Creek, the agencies claim fishing below Llewellyn Falls is a threat to the Paiute CT but still promote it. If the Paiute CT is as threatened and as rare as the agencies claim, why have they not closed the entire stream below Llewellyn Falls to fishing? And why are they promising a new fishery for Paiute CT and taking selected people into the closed area above Llewellyn Falls to fish? These issues have not been fully disclosed or analyzed in the EIR or NPDES permit.

In addition, CDFG, in 1991, moved salvaged hybrid fish from Silver King Creek into reaches of the East Fork Carson River below Carson Falls near the Soda Springs Ranger Station (Ryan in Schaffer 1992, Ex 15) that have been designated Wild Trout waters since 1972 (no artificial stocking allowed). (Deinstadt et al. 2004).

VIII. <u>The Lahontan Board did not give the public adequate time to comment on the proposed permit after the EIR was certified, and delayed issuing the final permit for appeal.</u>

The Lahontan Board has stated that it is "proceeding as a CEQA responsible agency," but it refused to honor the letter sent by the FWS and CDFG to commenters, June 15, 2009, that assured the public that they would have a 30-day comment period after the EIR/EIS was completed to review the proposed NPDES permit prior to the Regional Board's public hearing. (Ex 16).

The Public had only a few days, less than a week, to review the voluminous EIR/EIS and compare it with the proposed NPDES permit before the deadline for written comments on the NPDES permit were due. The Final EIR was released on March 16; comments were due on March 22 for the NPDES permit. (Ex 16).

The Lahontan staff refused to postpone the hearing and failed to extend the review period for the public. But petitioners learned at the hearing that a large notebook of material about an inch and a half thick with about 25 exhibits had been submitted to the Board by the CDFG. There was no reasonable possibility for the public, some who traveled several hours to be at the hearing, to review that material prior to the hearing or at the hearing. Only one copy was available at the hearing on a side table. And subsequently, petitioners learned that the material had been submitted to and accepted by the Board on April 5, well after the March 22 deadline for the "Submittal of Written Material for Water Board Consideration" given in the Agenda Announcement for the April 14–15 meeting. (Ex 16).   This shows preferential treatment to CDFG and prejudicial treatment of the public.

A similar situation has occurred with regard to this permit appeal. The Lahontan Board decided the night of the hearing, April 14, 2010, to adopt the NPDES permit, but the final revised permit was not released until April 28, 2010. Thus, instead of having 30 days to submit an appeal, the public had 16 days. (Ex 16).

This behavior toward the public by a public agency is unacceptable and contrary to the spirit of the law and the requirement to consider public comment and provide opportunity for review of agency decision-making.

CONCLUSION

For all the reasons set forth herein, and in materials previously submitted to the agencies on this matter, Petitioners respectfully request that the State Board grant this appeal and reverse the Lahontan Board's decision adopting the NPDES Permit for the Silver King Creek poisoning project.

Dated: May 14, 2010

Respectfully submitted,

/s/ *Julia A. Olson*

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I, Julia A. Olson, declare as follows:

1. I am counsel for petitioners in this action requesting review of the Lahontan Regional Water Quality Control Board's ("Lahontan Board") adoption of NPDES Permit No. CA103209. I have knowledge of the facts stated herein.

2. Petitioner's and the public's interest will be substantially harmed if a stay is not granted. California Department of Fish and Game ("CDFG") cannot poison Silver King Creek without the NPDES Permit adopted by the Lahontan Board. If the NPDES Permit remains in place, in the absence of a stay of its adoption, CDFG may proceed to poison Silver King Creek as early as August, 2010.

3. Once Silver King Creek has been poisoned, the harm to aquatic organisms, water quality and existing beneficial uses, described in the attached petition for review will have occurred and will be irreparable. This harm would include long-term or permanent reduction in existing aquatic invertebrate populations. It may also include the permanent extirpation of rare and endemic aquatic invertebrate species from Silver King Creek. Harm may also occur to amphibians, including the mountain yellow-legged frog and the Yosemite toad. All of these harms to water quality and species also harm the wilderness resource mandated for protection under federal law.

4. If the Silver King Creek poisoning with CFT Legumine has similar problems that CDFG's poisoning of Lake Davis had in 2007, rotenone will not neutralize immediately and will be found in sediments weeks after project completion.

5. These harms, once inflicted, cannot be reversed.

6. In contrast, there is no urgency for this project and there will be no substantial harm to the public, CDFG or others if this project is delayed one more year. Paiute cutthroat trout populations do not face any imminent threat that would require project implementation this summer.

7. This petition presents substantial questions of law and fact for the State Board to resolve. The adoption of this permit results in multiple violations of the Basin Plan, the Clean Water Act, Porter-Cologne Water Quality Control Act and CEQA.

I declare under penalty of perjury and the laws of the State of California that the foregoing is true and correct to the best of my knowledge.

Executed this 14th day of May, 2010 at Eugene, Oregon.

/s/Julia A. Olson

Julia A. Olson

List of Exhibits

1. Letter from N.A. Erman to Chair, LRWQCB, Sept. 10, 2002.
2. Erman and Erman 2006
3. Singer letter to FWS. 2006. Scoping
4. Special Animals list NDDB
5. Erman and Erman 2009 [submitted to LRWQCB]
6. Erman and Erman 2010a---Comments to LRWQCB, Mar 22, 2010
7. CFT Legumine product label
8. Erman and Erman 2010b. Comments on Final EIS to FWS
9. Erman and Erman 2005. Comments to EPA ---NPDES permit/FIFRA
10. Cordes et al. pages
11. Photo of largest falls in Silver King Canyon under low water.
12. Ecological Angler–East Carson Fishing and Photo
13. CDFG invitation to fish for Paiute CT above Llewellyn Falls
14. Deinstadt et al. pages
15. Schaffer book pages
16. Unequal treatment in NPDES permit process (includes several letters announcements, e-mails)
17. Petition for writ of mandate
18. NPDES Permit No. CA103209

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DECLARATION OF SERVICE

I, JULIA A. OLSON, declare:

I am, and was at the time of this service over the age of eighteen and not a party to the above-entitled cause. My business address is 2985 Adams Street, Eugene, OR 97405, and I am a resident of or employed in the County of Lane, Oregon.

On May 15, 2010, I served the attached **PETITION FOR REVIEW OF NPDES PERMIT ADOPTION; DECLARATION OF JULIA OLSON and 18 EXHIBITS** via electronic mail on the following:

State Water Resources Control Board
Office of Chief Counsel
Jeannette L. Bashaw, legal analyst
jbashaw@waterboards.ca.gov

Lahontan Regional Water Quality Control Board
Executive Officer
Harold Singer
hsinger@waterboards.ca.gov

California Department of Fish and Game
Stafford Lehr
Senior Environmental Scientist and contact for Paiute Cutthroat Trout Restoration Project
slehr@dfg.ca.gov
and
John McCamman, Director
director@dfg.ca.gov

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that this declaration was executed on May 14, 2010, in Eugene, Oregon.

/s/ Julia A. Olson

JULIA A. OLSON

43200 East Oakside Place
Davis, CA 95616
e-mail: naerman@ucdavis.edu
September 10, 2002

Chair
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Boulevard
South Lake Tahoe
California 96150

Dear Chair and Members of the Lahontan Regional Water Quality Control Board:

Enclosed are my comments on the EA prepared by the Humboldt-Toiyabe National Forest for the proposed rotenone poisoning of the Silver King Creek watershed, Carson-Iceberg Wilderness. I have not included exhibits A (comments on US Forest Service scoping document filed May 29, 2002) or exhibit B (comments on the CDFG Negative Declaration filed June 12, 2002) because I sent those to you earlier. For all of the reasons I have raised in these EA comments, I feel that a joint EIR/EIS is necessary for this project.

I thank your staff for sending their comments of June 27, 2002 to me. I agree with the assessment of your staff that the studies cited by CDFG do not "convincingly demonstrate that the proposed project will have no significant adverse impacts on non-target benthic communities." Further however, based on my analyses of the same studies, I feel they show that three years following the end of the last rotenone poisoning in Silver King Creek, there were still consistent decreases in the number of Plecoptera (stoneflies) taxa in common between the pre-treatment samples and post-treatment samples, and there were evident decreases in the number of taxa at the genus or species level. This evidence, combined with an assessment using Margalef's index of diversity, indicated that Plecoptera diversity had increased somewhat at the control station during the same period and had decreased substantially at all but one of the treatment stations. I would be glad to discuss these findings with your staff and have included more detailed discussion in the enclosed comments.

These findings are in conflict with the current water quality objectives for the East Fork Carson River Hydrologic Unit and the Lahontan Basin Plan because established objectives were not met for non-target aquatic organisms within one year following rotenone treatment. In addition there is no way to determine, based on the studies that the CDFG has been producing, that these objectives can be met in the future.

I think it would be highly inappropriate for the LRWQCB to authorize this project based on the inadequate CEQA and NEPA documents prepared by the CDFG and the Forest Service, and that the LRWQCB, as a responsible agency under CEQA, should require that a joint EIR/EIS be prepared following the completion of all other state and federal agency documents pertaining to this project.

Please keep me informed of your intention to authorize or deny authorization for this project. Would you please also send me copies of the finalized monitoring plan and the quality assurance plan which were to be sent to your staff in early July 2002 (letter from Ken Mayer, CDFG to Harold Singer, May 7, 2002). Thank you for your attention to these matters.

Sincerely,

Nancy A. Erman
Specialist Emeritus, Aquatic ecology/
freshwater invertebrates
University of California

Comments submitted by e-mail to: opp–docket@epa.gov. PLEASE CONFIRM RECEIPT. Document is 22 pages including 8 figures. Hard copy to follow by mail to:

Public Information and Records Integrity Branch (PIRIB) (7502C),
Office of Pesticide Programs (OPP),
Environmental Protection Agency,
1200 Pennsylvania Ave., NW, Washington, DC 20460-0001.
Docket ID No. OPP-EPA-HQ-2005-0494.

April 10, 2006.

To:
Environmental Protection Agency
Rotenone Risk Assessments
Attention Docket ID No. OPP-EPA-HQ-2005-0494

From:

Nancy A. Erman
Specialist Emeritus
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We are aquatic ecologists who have reviewed over the past several years many of the rotenone poisoning projects conducted or proposed by the California Department of Fish and Game (CDFG) on streams and lakes on public land in California and by other state fish and game agencies, by the US Fish and Wildlife Service (FWS), and as permitted by the USDA Forest Service (US Forest Service) throughout the West. We are submitting these comments as private citizens in the public interest. We are commenting specifically on the effects of rotenone when used as a "piscicide" in the nation's streams, rivers, and lakes.

Rotenone versus synergized rotenone formulations:

The Environmental Protection Agency should recognize and distinguish among the many formulations of "rotenone." Pure rotenone is rarely used in fish poisoning operations. For example, the formulation of choice by CDFG in California over the past many years has been Nusyn-Noxfish, which contains other toxic cube resins, such as deguelin, and piperonyl butoxide in percentages equal to rotenone. Deguelin, tephrosin and other rotenoids have been shown in published reports to have the same properties as rotenone as an insecticide. Piperonyl butoxide is highly acutely toxic to aquatic macroinvertebrates (EPA, National Pesticide Telecommunications Network). These formulations also contain many other inert ingredients that are not desirable for release into natural waters.

Collateral damage to non-target species and aquatic communities from the application of rotenone formulations:

Rotenone formulations can not be referred to merely as "piscicides" (as this EPA announcement has) thereby implying that they kill only fish. In fact, rotenone formulations act as a poison on many non-target organisms and have major long-term impacts on aquatic invertebrates and on amphibians. Rotenone inhibits the ability of fish and other aquatic animals that obtain oxygen from water, to use oxygen.

The CDFG and the US Forest Service have recently been requesting rotenone projects of three years duration, with up to two applications per year, because they have had so little success in eliminating unwanted fish with one-year applications (e.g., US Forest Service Decision Notice 2004). And often these poisoning regimens have been repeated on approximately 10-year cycles in the same stream basins or lakes. The great majority of aquatic invertebrates have one-year life cycles. A three-year project eliminates many invertebrates from the stream and riparian area for as long as four years and longer. Many terrestrial animals are dependent on the food source of emerging stream insects, amphibians, and fish and are put at risk from these projects because a major part of their food supply is eliminated for several years. This cascading effect in food webs is a major ecological disturbance.

The impacts of rotenone on aquatic invertebrates are well known, have been studied for many years and continue to be studied (e.g. Almquist 1959, Binns 1967, Meadows 1973, Helfrich 1978, Engstrom-Heg et al. 1978, Chandler 1982, Dudgeon 1990, Mangum and Madrigal 1999, Cerreto et al. 2003). The impacts are variable depending on the sensitivity of each species to rotenone. Some species may be eliminated or greatly reduced while more resistant species are increased after rotenone poisoning. Cosmopolitan or “weedy” colonizer species, relatively insensitive to rotenone, tend to replace more sensitive species and the overall species diversity decreases.

Most of the aquatic invertebrate studies have been short-term. Most have only identified larval aquatic insect forms and, therefore, have not determined the number of species affected or eliminated by rotenone. If a higher taxon than a single species is affected, one can assume that a higher number of species is being affected. For example, when a study reports that a genus, family, or order has disappeared or shown major stream drift, one must assume the taxon represents more than one, and perhaps many, species.

In a short-term study on a Pennsylvania stream, Helfrich (1978) found that all 4 major orders of macroinvertebrates in the study stream exhibited substantial decreases in numerical abundance 11 days after rotenone treatment. Populations of Plecoptera and Diptera were "nearly exterminated." Trichoptera and Ephemeroptera were reduced to 50% of the pretreatment levels.

A 5-year study on a river in Utah (Mangum and Madrigal 1999) found that "up to 100% of Ephemeroptera, Plecoptera, and Trichoptera [mayflies, stoneflies and caddisflies] were missing after the second rotenone application. Forty-six percent of the taxa recovered within one year, but 21% of the taxa were still missing after five years. At least 19 species were still missing five years after the rotenone treatments. (We say "at least" because some taxa were identified only to genus and may have included more than one species). It should be noted that the rotenone formulation that was used in the Mangum and Madrigal study was Noxfish, which does not contain the synergist piperonyl butoxide found in

Nusyn-Noxfish. We would expect even more toxic effects to macroinvertebrates from Nusyn-Noxfish.

The California Lahontan Regional Water Quality Control Board required that the CDFG conduct monitoring on aquatic macroinvertebrates before and after the application of Nusyn-Noxfish to several streams in the Lahontan region. We have obtained CDFG reports and data from two of those studies, one on Silver King Creek, 1990 through 1996 (Trumbo et al. 2000 a), and the other on Silver Creek, 1994 through 1998 (Trumbo et al. 2000 b), both in the Carson–Iceberg Wilderness Area, Humboldt-Toiyabe National Forest, CA. We also obtained most of the original data reports that were prepared by the USDA Forest Service, National Aquatic Ecosystem Monitoring Center Laboratory, Provo, Utah for these two CDFG reports.

F.A. Mangum of the National Aquatic Ecosystem Monitoring Center Laboratory, prepared the reports from data collected before and after the 1991-1993 poisoning of Silver King Creek above Llewellyn Falls. We found the following quotes in the data report submitted to the California Department of Fish and Game in 1997 from the USDA Forest Service, National Aquatic Ecosystem Monitoring Center Laboratory, Provo, Utah. (Mangum, F.A. 9 Jan. 1997. Aquatic Ecosystem Inventory - Macroinvertebrate Analysis Silver King Creek, 1996. USDA Forest Service, National Aquatic Ecosystem Monitoring Center Laboratory, Provo, Utah):

<u>Station 1, Control Section, Four Mile Creek</u>

"Many of the species missing in Silver King Creek following rotenone treatments were still found in Four Mile Creek." (p. 8)

<u>Station 2, Silver King Creek</u>

"16 taxa (33%) found in the pre-rotenone community were still missing;" (p. 14)

<u>Station 3, Silver King Creek</u>

"There were still 11 taxa or 28% of the pre-rotenone community still missing at this station;" (p. 15)

<u>Station 6, Silver King Creek</u>

"…there were still 17 taxa or 38% of the pre-rotenone community missing;" (p. 15)

<u>Station 7, Silver King Creek</u>

"…but 13 taxa (30%) were still missing from the pre-rotenone community at this station; see Table 4. Most of the missing taxa have been observed to be sensitive to rotenone." (p. 16)

Station 8, Silver King Creek

"There were still 14 taxa (30%) missing at this station compared to pre-rotenone samples;" (p. 17).

Our analysis of the same data indicates an even higher number of macroinvertebrate taxa missing three years after the last poisoning on Silver King Creek. The average percent missing taxa from the five treatment stations was 41.9%; the highest percent taxa missing from a single station was 46.7%.

Some of our analyses of these data are summarized in Figures 1 through 8. We found that macroinvertebrate diversity in Silver King Creek was significantly reduced two and three years (considered long-term in the Lahontan Basin Plan) following poisoning with Nusyn-Noxfish (Fig. 1) and that peltoperlid stoneflies were greatly reduced in the long-term (Figs. 2 and 3). Percentage of taxa that were still the same at the poisoned stations after they were poisoned compared to before was significantly lower than at the control station (Fig. 4). In Silver Creek (a different stream from Silver King Creek) the mean number of taxa were significantly reduced two years after the last poisoning (Figs. 5 and 6), stonefly abundance was greatly reduced (Fig. 7), and peltoperlid stoneflies had nearly disappeared two years after the last rotenone poisoning (Fig 8). The peltoperlid stoneflies had been the most abundant stonefly group prior to poisoning.

In 2003, CDFG provided the Lahontan Regional Water Quality Control Board (LRWQCB) staff misleading information when they claimed that "No evidence of long-term impacts were found in either study" (Interagency Study Proposal, LRWQCB files, June 15, 2003, Evaluation of Rotenone use in Silver King Basin on Aquatic Macroinvertebrates, 2003-2007). Our analysis of the data available in the reports showed otherwise.

Our analyses of these data will continue as agencies release the data to us. However, it has been extremely difficult to get all the data and the US Forest Service and CDFG failed to release a complete set of data from these two streams even to the Lahontan RWQCB after the Board formally requested it.

We know that an average of 41.9% of the broad taxa of macroinvertebrates were still missing from the Silver King Creek drainage as long as three years following the last rotenone treatment. We do not know how many species these taxa represent. To our knowledge, neither the US Forest Service, CDFG, nor the USFWS have ever made an inventory of macroinvertebrate species prior to a stream or lake poisoning project in California. There is no way to know whether or not other rare and/or endemic macroinvertebrate species are in a project area prior to poisoning or whether or not any of the macroinvertebrate species ranked as endangered, restricted range, or rare in the California Natural Diversity Database are present. We think this lack of knowledge of aquatic species present prior to rotenone poisoning extends throughout the US.

Many of the stream poisoning projects now being carried out or proposed in the western US are in the most pristine and unspoiled streams and rivers of the country in designated Wilderness Areas and national parks. Many are in isolated headwater areas that have a high probability of containing other rare and endemic aquatic species, for the same reason that they have rare subspecies of fish. Our research has revealed rare and/or endemic species of invertebrates in many springs and headwater reaches in the Sierra (e.g., Erman and Erman 1990, 1995). We also have found that aquatic invertebrate species persist in undisturbed streams over many years. Other researchers also have found persistence of invertebrate taxa in undisturbed streams over many years (e.g., Robinson et al. 2000). These are the sites that should be most protected.

Studies of insect dispersal in Europe have found that biological recovery of aquatic insect communities following insecticide poison events or severe organic pollution may take decades (Sode and Wiberg-Larsen 1993).

The mountain yellow-legged frog and the Yosemite toad are both candidates for listing as endangered species and both are or were found in stream basins in the Sierra Nevada that are proposed for fish eradication or where fish eradication has been attempted for many decades. There is no time during the year that tadpoles of the mountain yellow-legged frog would not be in a stream in higher elevations because the mountain yellow-legged frog spends up to four years as a tadpole. Adult frogs are highly aquatic compared to other amphibian species (Dr. Kathleen Matthews, USDA Pacific Southwest Experiment Station 2003, High Sierra Ecosystems, Science Perspectives, USDA Pacific Southwest Experiment Station).

Inability of fish and game departments to properly manage rotenone applications in the field:

Use of rotenone as a fish poison requires that rotenone must be neutralized chemically in order to control its toxic effect downstream from treatment areas. This chemical neutralization is commonly attempted with potassium permanganate. Failure by the CDFG to achieve complete neutralization and to cause fish kills from the potassium permanganate itself is documented in California Regional Water Quality Control Board (RWQCB) files.

We have read reports from the Lahontan RWQCB files and from CDFG files. During rotenone poisoning of Silver King Creek, Mono County, 1992, approximately 1000 fish were killed downstream of the project area from the application of potassium permanganate (Lahontan RWQCB files). The following year, 1993, during a repeat poisoning of the same area, detoxification of the rotenone was chemically incomplete (Flint et al. 1998). The record shows that CDFG has difficulty managing the performance of potassium permanganate and detoxifying the rotenone.

In the Lahontan Region alone, 6 of 11 rotenone projects since 1988 have violated water quality standards. Rotenone, rotenolone, or naphthalene have been detected downstream or have persisted longer than limits established in Basin Plans (Lahontan RWQCB files).

During application of rotenone in Silver Creek, Mono County, in 1994, independent testing by the Regional Water Quality Control Board found carcinogenic compounds in water. In contrast, testing by CDFG at the same sites found no detectable carcinogenic compounds (Lahontan RWQCB files).

Rotenone was detected in sediment during a CDFG project in Silver Creek, Sept. 20, 1995. CDFG was well over their target application rate of rotenone, with data apparently missing at a critical period (Lahontan RWQCB files).

Rotenone and its breakdown products have persisted in water for long periods after CDFG poisoning projects (Lahontan RWQCB files).

Higher amounts of rotenone have been used than are recommended because of accidents (e.g., Flint et al. 1998). In Silver King Creek non-native fish in live cars (used to monitor effectiveness of the poison) escaped into the stream section being poisoned, not once but twice (Flint et al. 1998). As a result, “the creek was heavily doused with rotenone from backpack sprayers so that total concentrations peaked at 40 μg/l at detox, about twice (sic) expected.” Not all the escaped fish were found (Flint et al. 1998). Thus, even as CDFG was attempting to get rid of fish, they were accidentally introducing them.

Rotenone can not solve the problem of unwanted fish species

Until the responsible agencies recognize and acknowledge the underlying reasons for many of the unwanted species in the nation's waters and riparian zones, they will be unable to solve the problems with pesticides.

Non-native fish species have been and continue to be stocked by state fish and game agencies and by the US Fish and Wildlife Service. These species were/are stocked without environmental review and constitute a form of biological pollution. Perhaps the greatest threat of these stocking programs is the lesson they teach the public: it is a good idea to move fish around. For this reason and because of the continued official agency fish stocking, few fish eradication projects are successful in removing unwanted fish species over the long term (see for example, the decades-long records of poisoning streams and springs in the Golden Trout Wilderness and the Carson–Iceberg Wilderness, CA).

Rotenone formulations usually can not kill all the unwanted fish. An attempted fish eradication project in a reservoir, Lake Davis, CA, in the mid 1990s failed to eradicate the northern pike, poisoned a water supply for the town of Portola, and cost the state $15 million, some paid in reparations to the local community (Braxton-Little, Sacramento Bee, March 1, 2005). Components of the rotenone formulation, including piperonyl butoxide, persisted in the reservoir long after the poisoning was conducted. Portola has not used water from the reservoir since that time. The pike have been thriving in the intervening years, probably partly due to elimination of predators and competitors. The reservoir had been stocked with many non-native fish, but the northern pike was an illegal stocking, that is, a species not stocked by the CDFG. It is not easy for members of the public to understand why they can not stock the fish they want, if fish and game agencies can do it.

Freshwater habitats in the US are undergoing degradation and biological impoverishment from many sources (Erman 1996). It makes little sense to add poisons to streams and lakes in misguided attempts to save threatened and endangered fish without comprehensive understanding of why these fish species are endangered and with no concern for endangering other non-target species. It was never the intent of the Endangered Species Act to conduct recovery projects to increase single species that would put other species at risk of extinction.

Inadequate EPA review of connection between rotenone and Parkinson's Disease

The EPA rotenone risk assessment document has provided inadequate review and analysis of the connection between rotenone and Parkinson's Disease. In the various sections where the topic comes up, the EPA has repeated the statement "although several studies have linked sub-chronic rotenone exposure to Parkinson's disease-like symptoms in laboratory rats, the exposure methods used to obtain these results are not typically encountered through the current registered uses of rotenone." A critical analysis of the literature on this subject is restricted in the EPA document to the original study by Betarbet et al. (2000) and a paper on zebrafish by Bretaud et al. (2004). The Betarbet et al. study methods are critiqued and the findings judged of "uncertain relevancy" (p. 55 and elsewhere) as if this initial paper which first showed the connection between rotenone and Parkinson's disease is the sum total of current knowledge and technique. Such a review and analysis is insufficient for an EPA document of this importance.

The Web of Science presently lists 210 scientific papers connecting rotenone and Parkinson's disease. Many of these are extremely relevant to the EPA assessment, for example, Vanacore et al., 2002, have conducted a meta-analysis of all case control studies to the date of their work and are following the fate of a cohort of licensed pesticide users. More recently, Brown, T.P. et al., 2006, reviewed the extensive and growing literature on this subject and found "…a relatively consistent relationship between pesticide exposure and PD" and "…data suggest that paraquat and rotenone may have neurotoxic actions that potentially play a role in the development of PD…"

Inadequate EPA review of components of rotenone formulations

The EPA rotenone risk assessment document is incomplete in its treatment of ingredients associated with formulated end-products of rotenone. It has concluded that cube root resins do not contribute substantially to the toxicity of rotenone because technical grade rotenone is twice (at least) as toxic as the formulated end-product of rotenone. This conclusion is apparently based on the data reported in Table 3.17 for three formulations, Prentox Grass Carp Management Bait, Chem Sect Chem Fish Regular, and Chem Sect Cube Root Powder Toxicant.

However, the range of fomulations presented does not cover the range of actual formulations, associated products or potential toxicity. For example, work by Cabizza et al., 2004, found residues on olives of deguelin, tephrosin, and beta-rotenolone were very similar to rotenone and some data indicated similar acute toxicity values for deguelin and rotenone. The EPA and producers of rotenone products (e.g., Chem Sect Chem fish Regular, Table 3.17, and Nusyn-Noxfish and CFT Legumine) combine all such active compounds as "cube root resins" although their relative amounts and toxicities in end-product formulations are not equivalent. The limited data presented in Table 3.17 of the document support caution in making conclusions about toxicity of other cube resins. For example, Chem Sect Chem Fish Regular, 5% rotenone and 5% other cube resins, was 8 times more toxic to male rats than the other two products that contained no other cube resins. There are no data to reveal whether the other cube resins in Chem Sect Chem Fish Regular were rotenolone, tephrosin, deguelin or a mixture, or which was predominant.

Detailed work on extract from the source plant (*Lonchocarpus*) has found as many as 25 other minor rotenoids in cube resin (Fang andCasida 1999). Thus, other "cube root resins" is too broad a term for useful toxicity characterization and a more complete discussion and review is required than is in the EPA document.

<u>Recommendations</u>

We recommend 1) that the use of rotenone as an aquatic poison be halted in most cases in the US, 2) that its use should always require an NPDES permit [See earlier comments we submitted to the EPA, Attention Docket ID No. OW–2003–0063, April 1, 2005], and 3) that where it is permitted, application should be monitored and overseen by an independent, unbiased agency. The agencies promoting the use of rotenone in stream and lake poisoning can not be relied upon to also monitor and accurately report the effects of its use. We think that independent aquatic scientists, including macroinvertebrate and amphibian specialists, must be involved in the analysis of the impacts of rotenone on aquatic communities and species of non-target organisms.

<u>Summary</u>

To summarize, aquatic poisons rarely solve the problems for which they are used because the same fish and game agencies that promote them continue to stock non-native fish. Members of the public learn from the example of the agencies and also move fish around. And fish poisoning often does not kill all the target fish.

The record is clear that the state and federal agencies using rotenone in California streams and lakes are incapable of applying the products without major problems.

We think the impacts of rotenone use in the streams and lakes of the US over the past 60 or 70 years has significantly reduced the diversity and changed the communities of aquatic macroinvertebrates and has probably eliminated some, perhaps many, non-target species. It has likely also had a major effect on some amphibians and has had a secondary food web effect on terrestrial animals that depend on fish, amphibians, and emerging aquatic insects for food. The effects of "piscicides" in general on non-target species have been understudied, poorly analyzed, and denied or ignored by some of the state and federal agencies involved in stream and lake poisoning.

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<u>Explanation of figures</u>:

<u>Figure 1</u>. Silver King Creek Macroinvertebrate Diversity Long-term Response to Nusyn-Noxfish (a rotenone poison).

Plot of the Margalev diversity index. Data is from Trumbo et al. (2000a) It compares the mean diversity index (± 1 standard error) for the control site (Station 1 in Trumbo et al. 2000a) and the sites eventually poisoned (Stations 2, 3, 6, 7, 8). The bars labeled "Before" are mean values for the two years before poisoning (1990 and 1991 before poison). The bars labeled "Long-term" are mean values for the two years, 1995 and 1996, following the last poisoning in 1993.

<u>Figure 2</u>. Silver King Peltoperlid Stoneflies.

Mean number of individuals (± 1 standard error) of the stonefly family Peltoperlidae, a taxon difficult to mistakenly identify. Data are from Trumbo et al. (2000a). Data in the Trumbo et al. (2000a) report are in tables of Plecoptera by taxon. Values for all taxa in the family Peltoperlidae (i.e., *Yoroperla brevis*, *Yoroperla* and Peltoperlidae) were summed for each date and station. "Before" on the x-axis means before poison and includes the samples from 1990 and 1991 (before poisoning). "During" includes the samples from 1991 after poisoning, 1992 before and after, 1993 before and after, and 1994 (one year after final poisoning). "Long-term" includes samples from 1995 and 1996, two and three years following the final poisoning.

<u>Figure 3</u>. Percentage of Peltoperlidae in Silver King Creek (of all Stoneflies).

This plot is of the same data and source as Fig. 2 except the number of individuals of Peltoperlidae from the poisoned stations (Stations 2, 3, 6, 7, 8) are divided by the total number of individuals of all taxa and expressed as a percentage (± 1 standard error). The periods and samples are the same as in Fig. 2.

Figure 4. Percentage of taxa the same as those found before poisoning began, Silver King Creek.

The mean of 5 poison stations includes ± 1 SE. Data were not available for 1992 at the Control station. 1992 and 1993 include samples from before (b) and after (p) poison applied. Long-term results are considered those of 1995 and 1996 according to Lahonton Basin Plan. (Data from Mangum 1991, 1993-1996)

Figure 5. Silver Creek Number of Taxa.

Mean number of taxa (±1 standard error) from a study on Silver Creek (a different stream from Silver King Creek) reported in Trumbo et al. (2000 b. There was no control station in this study. The years are given under the periods used to calculate Before, During and Long-term. All four stations are used to calculate the mean for each bar.

Figure 6. Silver Creek Number of Taxa showing time of poison (Nusyn-Noxfish) application.

This is a plot of the mean number of taxa from Silver Creek based on the same data (Trumbo et al. 2000 b) shown in Fig. 4. The sample periods are given on the x-axis and vertical arrows indicate time of poisoning.

Figure 7. Silver Creek Stonefly abundance

Plot of mean (± 1 standard error) number of individuals (for all taxa in the Stonefly order) for Silver Creek based on data in Trumbo et al. (2000 b). Data are grouped as in Fig. 5. All four stations are used for each bar.

Figure 8. Silver Creek Peltoperlid Stonefly Abundance.

Mean number of individuals (± 1 standard error) of the family Peltoperlidae. The data are from the report by Trumbo et al. (2000 b). Times and stations are as in Fig. 6.

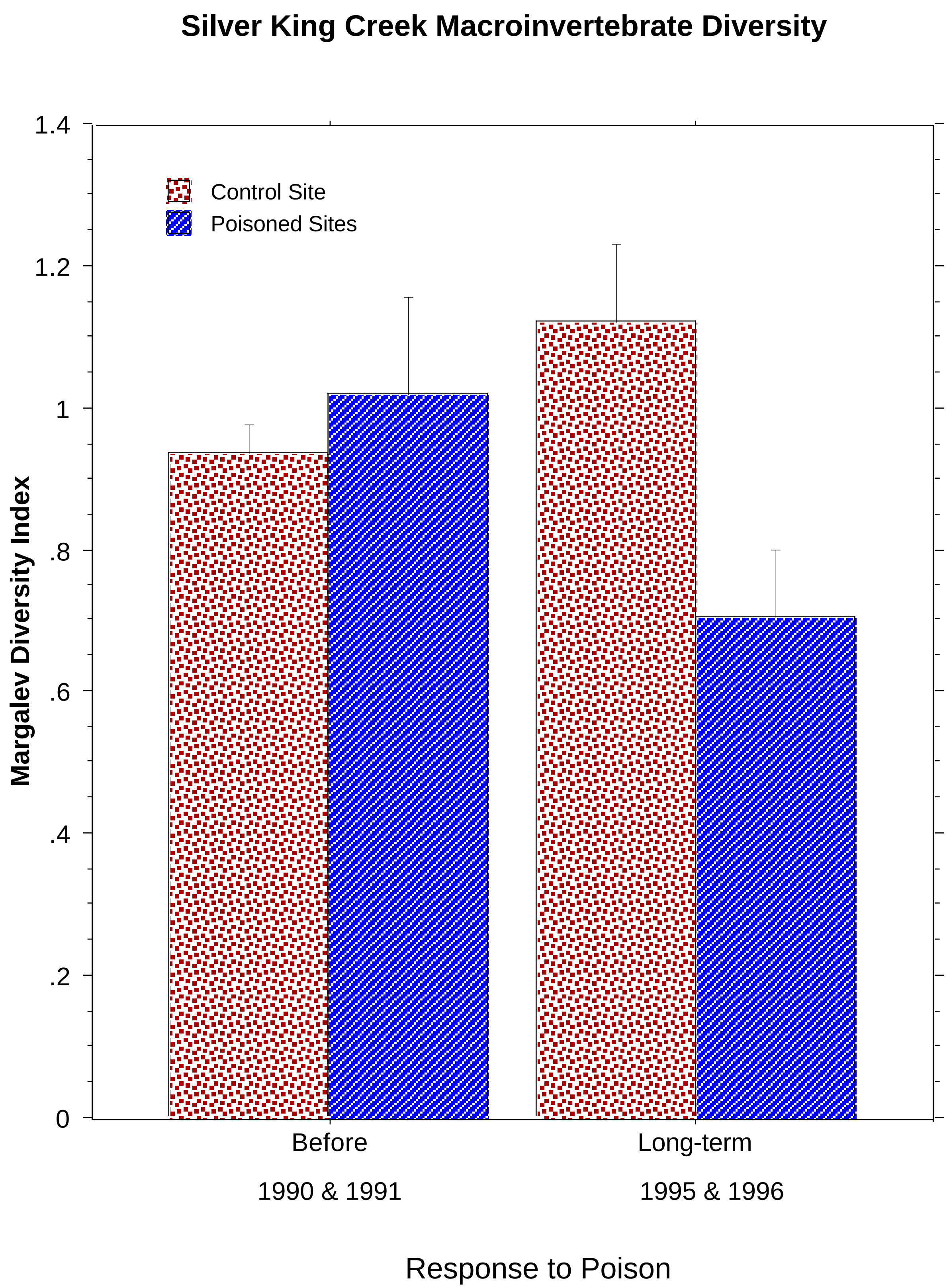

Figure 1. Silver King Creek macroinvertebrate diversity long-term response to Nusyn-Noxfish (a rotenone poison).

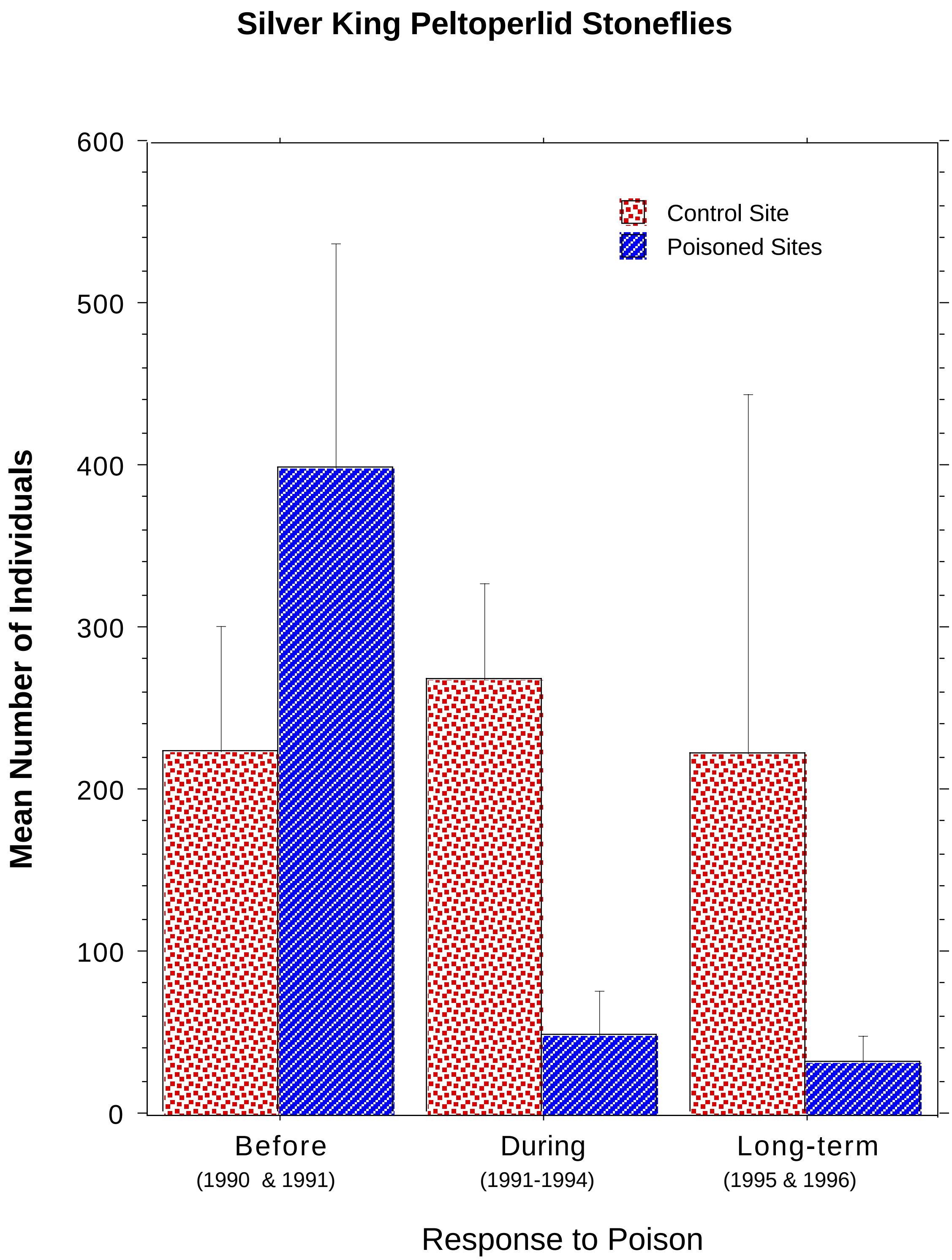

Figure 2. Silver King peltoperlid stoneflies.

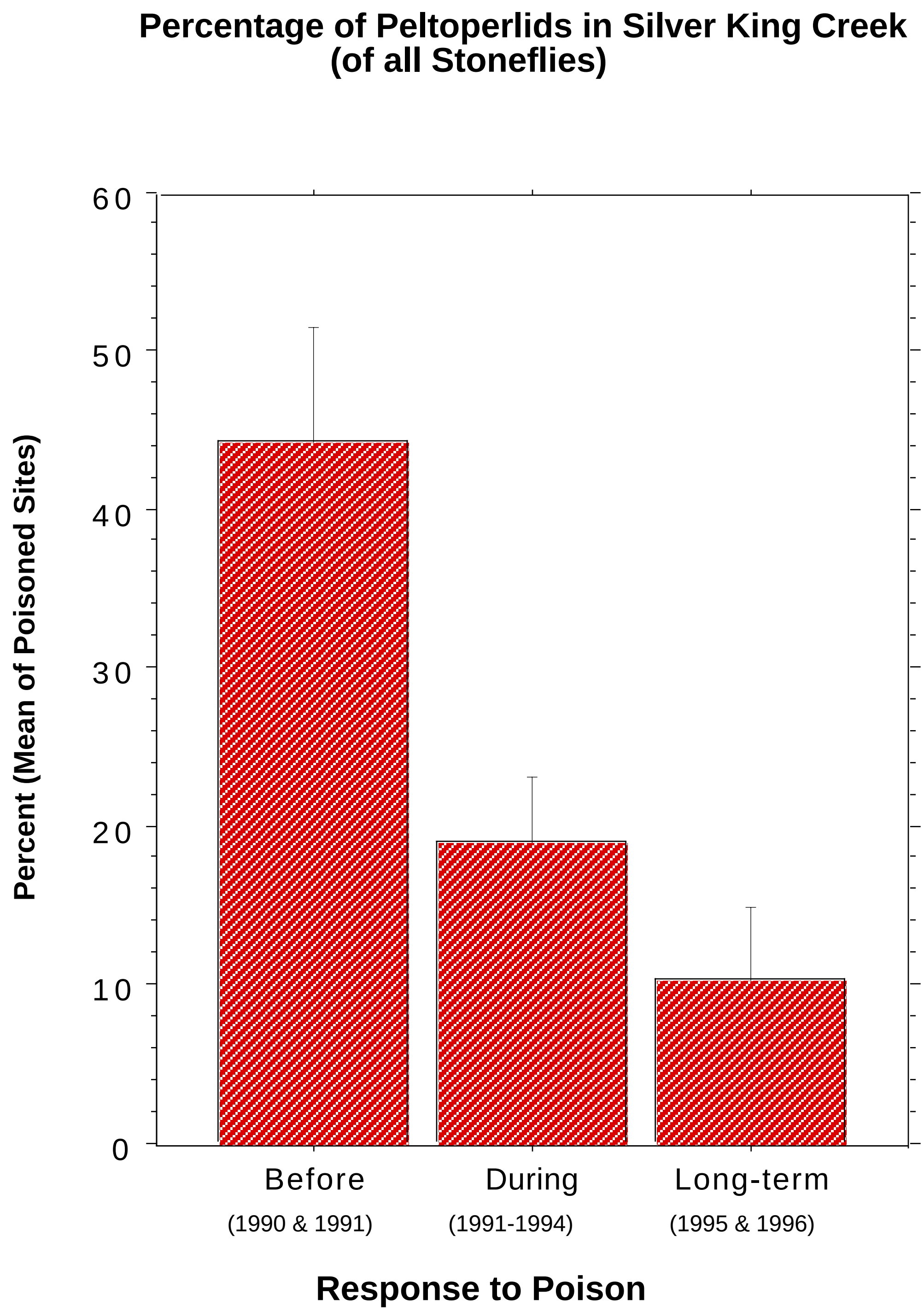

Figure 3. Percentage of peltoperlids in Silver King Creek (of all stoneflies).

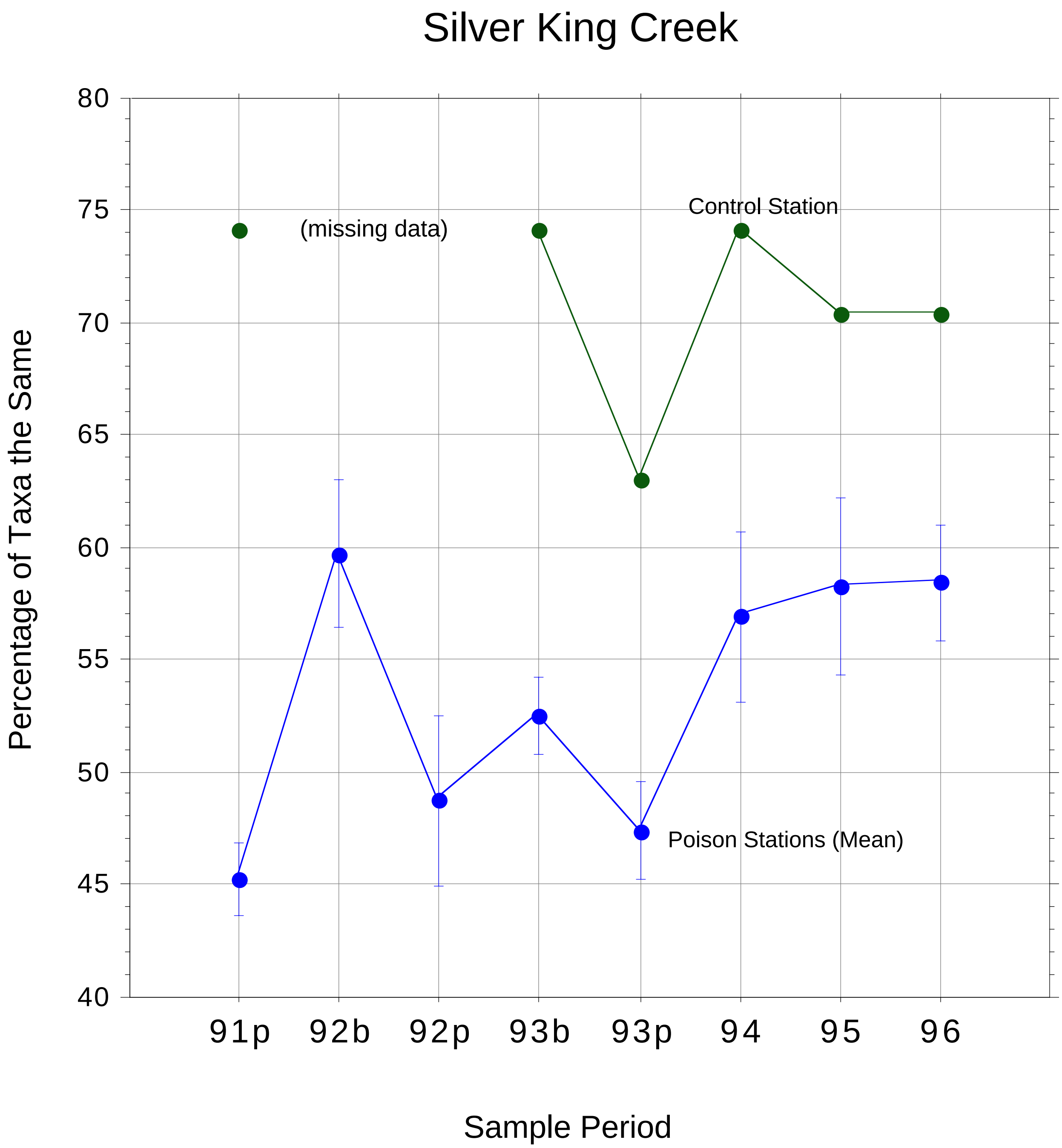

Figure 4. Percentage of taxa the same as those found before poisoning began.

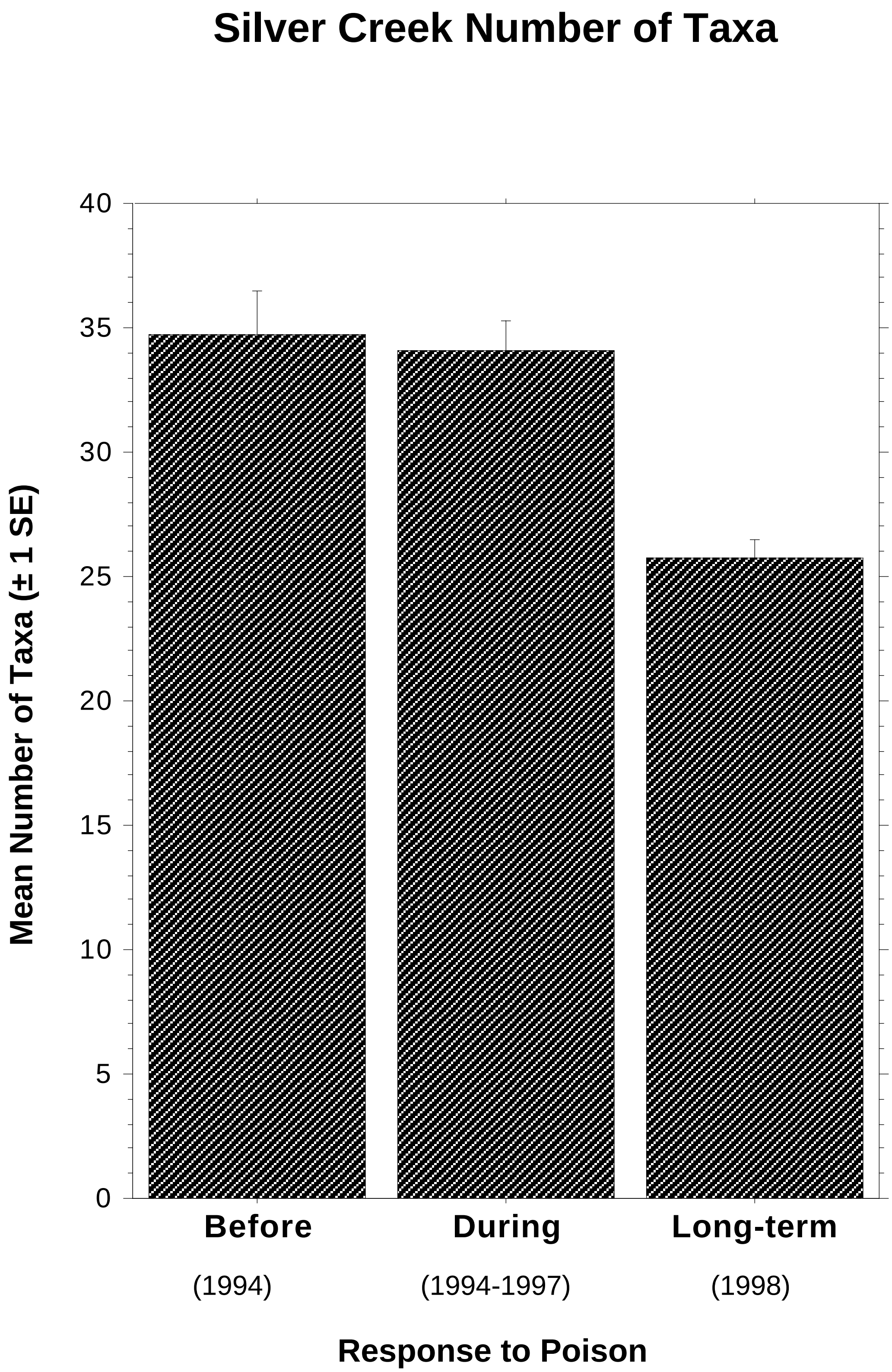

Figure 5. Silver Creek number of taxa.

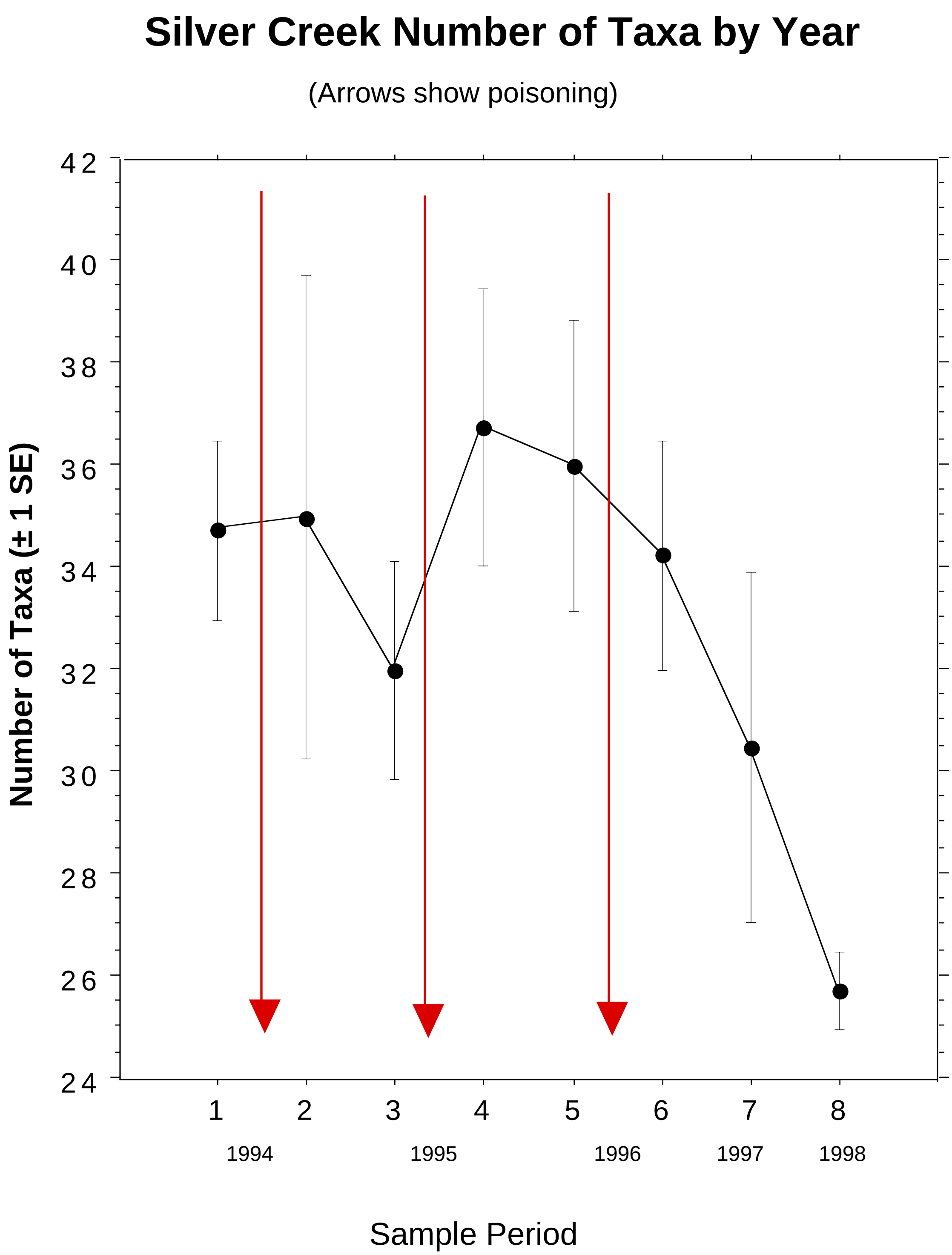

Figure 6. Silver Creek number of taxa showing time of poison (Nusyn-Noxfish) application.

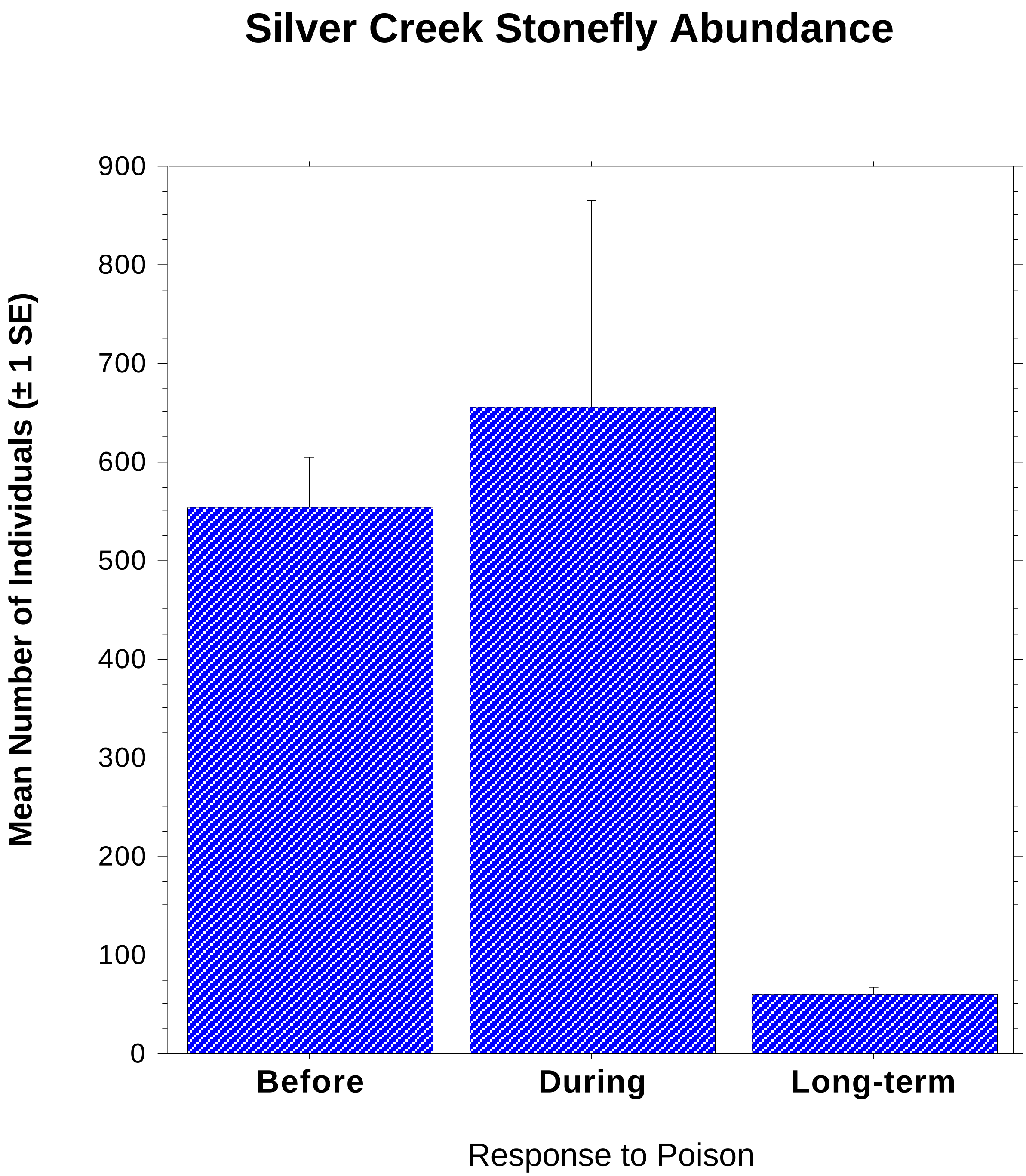

Figure 7. Silver Creek stonefly abundance.

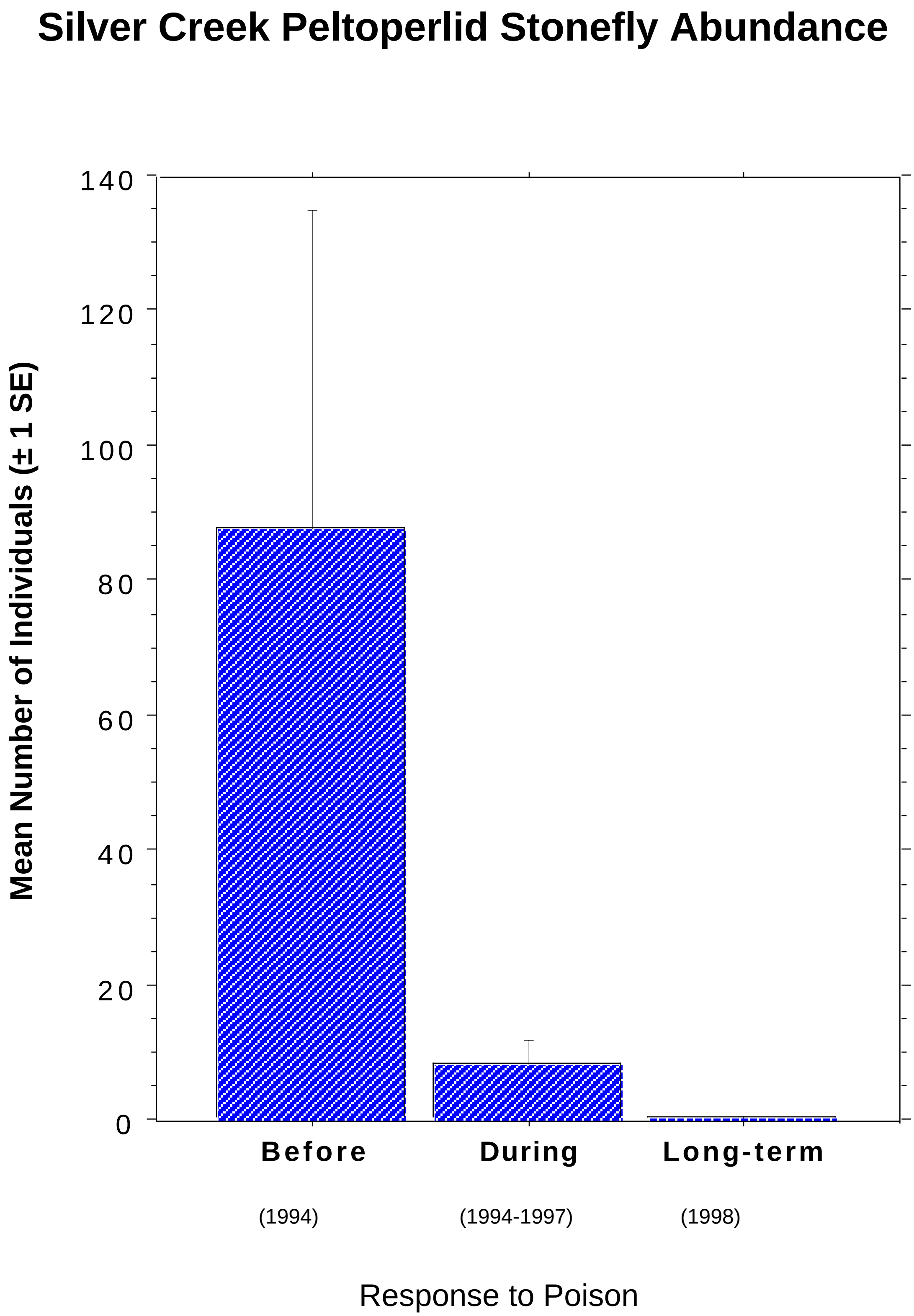

Figure 8. Silver Creek peltoperlid stonefly abundance.

California Regional Water Quality Control Board
Lahontan Region

Linda S. Adams
Secretary for Environmental Protection

Arnold Schwarzenegger
Governor

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Ex. C

JUL 0 3 2006

Robert D. Williams, Field Supervisor
Fish and Wildlife Service
Nevada Fish and Wildlife Office
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Reno, NV 89502

ROTENONE SCOPING COMMENTS FOR SILVER KING CREEK NEPA DOCUMENT

Thank you for the opportunity to provide scoping comments for the preparation of an Environmental Impact Statement (EIS) for the proposed Paiute Cutthroat Trout Restoration Project in the Carson-Iceberg Wilderness, Humboldt-Toiyabe National Forest, Alpine County, California. This project may have a significant effect on the environment and these effects both short term and long term must be analyzed in accordance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). This letter contains a number of enclosures containing evidence and concerns related to the potentially significant environmental impacts.

The Lahontan Regional Water Quality Control Board (Water Board) adopted a Water Quality Control Plan for the Lahontan Region (Basin Plan). The Basin Plan contains water quality objectives requiring that waters of the region shall not contain detectable levels of pesticides. The Basin Plan further provides for variances to be granted to the Department of Fish and Game for fish recovery projects if certain conditions can be met. Since the U.S. Fish and Wildlife Service (USFWS) is lead on this project, the Water Board may need to amend its Basin Plan to consider variance criteria for the USFWS for the proposed project. If Department of Fish and Game was the co-lead on the project, the Water Board may be able to use the existing criteria in the Basin Plan. Because the Water Board has to take discretionary action to grant a variance for the project, we need an environmental document that complies with the CEQA. A CEQA Lead Agency must still be identified. Because NEPA does not require separate discussion of mitigation measures, these points of analysis will need to be added, supplemented, or identified before the EIS can be used as an EIR. CEQA requires that the State Lead Agency shall consult as soon as possible with the Federal Lead Agency. We will need to meet with you and the Department of Fish and Game as soon as possible to discuss joint environmental document preparation.

EXHIBIT 3

Water Board staff has commented extensively on the 2002 Department of Fish and Game mitigated negative declaration (Kemper, 2002) and on the US Forest Service Environmental Assessment for this project (Churchill, 2002) and our comments are enclosed.

This project has been highly controversial and litigious. Most recently, the US District Court in Californians for Alternatives to Toxics v. US Forest Service on August 31, 2005 imposed an injunction. The proposed EIS must adequately address the issues raised in this lawsuit, our previous comments, and other comments on the proposed use of rotenone in the Silver King Creek watershed.

There are four issues requiring further evaluation in the EIS.

1. Rare, Unique, and Endemic Species: The primary issue in the most recent lawsuit and in the Water Board comments is the potential destruction of non-target rare and endemic species. Since many of these streams and headwater areas are isolated, there is the potential for rare and endemic species unique only to these waters. No evidence has been produced to date that any comprehensive biological survey has been done within the project area to assess whether any rare, unique and/or endemic species exists. Simply saying that they have not been observed, so they must not exist—as the defendant did in the above case—is not adequate, since if the project proponent is mistaken, an elimination of a unique species may occur from the rotenone application. At least two years of complete biological surveys to the species level should be conducted in these remote streams and headwater areas prior to commencement of any rotenone project. The draft EIS should provide a detailed survey plan and contingency measures to address protection of any rare species that could be adversely impacted from the rotenone treatment. This may require that alternatives to rotenone be considered for non-native fish species eradication in the areas that provide habitat for any rare or unique non-target species.

2. Short- and Long-Term Effects on Aquatic Community Composition: General toxic effects of rotenone are not strictly specific to fish, but all gill-breathing aquatic organisms. This includes juvenile species of amphibians and larval stages of insects—benthic macroinvertebrates. Studies on effects of rotenone on macroinvertebrates shows a consistent negative effect. Dr. David Herbst, an eminent aquatic biologist with the University of California at Santa Barbara, has the following to say about this regarding prior rotenone treatments and Silver King Creek:

   "Data suggest that (rotenone) treatments produced (1) a persistent high level of community dominance (a sign of stress at one taxon comprised 60-75% or more of all organisms relative to 20-35% before treatment), (2) transient loss of about 50% or more of EPT taxa (sensitive mayfly-stonefly-caddis taxa) during treatment years, followed by three years until levels had apparently recovered, and (3) persisting loss if stonefly taxa relative to pretreatment levels, with an especially notable loss of the abundant Peltoperlid *Yoraperia* through the post-treatment period."

He summarizes that "the potential for irreversible damage exists and recolonization of a rotenone-treated stream is at best uncertain...Management of streams for single species, whether listed or not, should not jeopardize the very ecosystems and biological communities into which such populations are being introduced."

Furthermore, when comparing pre- and post-rotenone treatment macroinvertebrate data, reliance on some standard metrics may be misleading because they may not (a) account for re-colonization with the same species that were present before treatment—other similar species or even genera could substitute; and (b) total macroinvertebrate abundance does not measure community structure. Metrics such as biotic index or a community similarity index will provide better information regarding post-treatment effects. If headwater areas are treated, re-colonization from drift of indigenous invertebrates is eliminated, and the stream will be re-colonized by more opportunistic and vagile species (those that disperse and colonize rapidly by flight and compete well in disturbed habitats). See Enclosure 7 for complete copy of Dr. Herbst's comments.

3. Other Toxic Compounds in Rotenone Formulations: Commercially available rotenone also contains toxic cube resins such as deguelin, piperonyl butoxide, and/or other carcinogenic compounds (See table in Enclosure 1). These compounds have also been shown to be toxic to macroinvertebrates, and should likewise be assessed along with rotenone in any rotenone formulation studies involving toxicity to macroinvertebrates.

4. Alternatives to Rotenone, Both Chemical and Non-Chemical: A chemical alternative to rotenone is antimycin, which has a persistence in the environment of hours compared to days or weeks with rotenone. Additionally, macroinvertebrate recovery is apparently much more rapid after application and it is more species-specific than rotenone. Many Federal resource management agencies have taken to using antimycin for species reintroduction projects as a result.

   Electroshocking in combination with gill netting has been a very effective non-chemical method for removing fish from lakes. This has been used successfully in 22 lakes for non-native fish removal projects in Sierra Nevada Mountains (Knapp and Matthews, 1998; Beecher, 2005).

   Detonation cord has likewise been successful in a number of recent DFG trials in the Sierra Nevada mountains (D. Becker, Associate Biologist, DFG, personal communication, 2006).

Please carefully review and evaluate all of the enclosed materials for consideration in the Environmental Impact Statement for the proposed project. We request that you consider several alternatives including limited rotenone use coupled with other measures to remove non-target species, and no rotenone use. Project contacts for this project are Dr. Bruce Warden, Environmental Scientist at (530) 542-5416 and Lauri Kemper, Division Manager at (530) 542-5436.

Harold J. Singer
Executive Officer

Enclosures:

1. Table 1 - Expected Chemical Concentrations of Rotenone formulations
2. Erman, Nancy and Don, 2006. *Comments on EPA Rotenone Risk Assessment* to USEPA.
3. Singer, 2005. *Regional Board Comments on State Water Board draft Order..., SWRCB/OCCFileA-1669 and A-1699(a)*, to Debbie Irvin, Clerk to State Board.
4. Kemper, 2004. *Follow-up to National Pollutant Discharge Elimination System (NPDES) Permit Hearing for Silver King Creek Rotenone Project, Alpine County*, to Banky Curtis, Regional Manager, DFG.
5. Kemper, 2004. *Updated Project Information Needed for Proposed 2004 Rotenone Treatment, Silver King Paiute Cutthroat Restoration Project, Alpine County*, to Banky Curtis, DFG.
6. Churchill, 2004. *Comments on Draft Revised Recovery Plan for Paiute Cutthroat Trout, Silver King Creek Rotenone Treatment, Alpine County*, to Reno FWS.
7. Herbst, 2002. *Comments on Draft Negative Declaration for Paiute Cutthroat Trout Habitat Restoration Project*, to State Clearinghouse
8. Kemper, 2002. *Comments on Mitigated Negative Declaration, Paiute Cutthroat Trout Habitat Restoration Project, State Clearinghouse #2002052136* to William Somer, DFG.
9. Churchill, 2002. *Comments on New Environmental Assessment, Silver King Creek Paiute Cutthroat Trout Restoration Project/Rotenone Treatment, Alpine County* to Jim Harvey, USFS.
10. Knapp, R.A. and K.R. Matthews. 1998. Eradication of Nonnative Fish by Gill Netting from a Small Mountain Lake in California. *Restoration Ecology* 6(2):207-213.
11. Becher, B. 2005. Frogs Trump Fish. *Los Angeles Times*, August 16, 2005

cc: Neil Manji / California Department of Fish and Game, Rancho Cordova
Nancy Erman
Laurel Ames
Dave Herbst

BW/adw t:\ FWS Rotenone NEPA Scoping Comments.doc

Ex 2

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME
Wildlife and Habitat Data Analysis Branch
California Natural Diversity Database

SPECIAL ANIMALS (673 taxa)
August 2004

The California Natural Diversity Database (CNDDB) is a continually refined and updated, computerized inventory of location information on the most rare animals, plants, and natural communities in California. The blueprint used to set up the CNDDB was developed by The Nature Conservancy (TNC) in the early 1970's. TNC has helped to set up similar programs in all 50 states and a number of foreign countries. Collectively these programs are known as the Natural Heritage Network. The "Heritage Methodology" used by all of these programs sets the standards on the information we gather and the procedures we use. In 1999 TNC and the Natural Heritage Network jointly established an independent organization, the Association for Biodiversity Information (ABI), to achieve their mutual goal of using the wealth of biodiversity information in the Heritage Network to support conservation efforts. In November 2001 ABI changed its name to NatureServe. More information the Natural Heritage Network is available on the NatureServe web site: http://www.natureserve.org.

EXHIBIT 4

Comparison of species listed on the California Natural Diversity Database and possible taxa of these species found in the Silver King Creek basin collections, 1984-2006.

Taxa Found Silver King Creek	Taxa in CNDDB	NDDB Rank
Pelecypoda (clams)		
Pisidium	*Pisidium ultramontanum*	G1S1
Coleoptera		
Elmidae		
	Atractelmis wawona	G1G3S1S3
	Dubiraphia brunnescens	G1G3S1S3
	Dubiraphia giulianii	G1G3S1S3
Trichoptera		
Limnephilidae	*Desmona bethula*	G?S?
Farula	*Farula praelonga*	G?S?
Cryptochia	*Cryptochia excella*	G1G3S1S3
	Cryptochia denningi	G?S?
Neothremma	*Neothremma genella*	G?S?
Ecclisomia	*Ecclisomyia bilera*	G1G3S1S3
Hydropsychidae		
*Parapsyche**	*Parapsyche extensa*	GHSH
Lepidostomatidae		
Lepidostoma	*Lepidostoma ermanae*	G?S?
Rhyacophiladae		
Rhyacophila	*Rhyacophila mosana*	G1G3S1S3
	Rhyacophila spinata	G1G3S1S3
Plecoptera		
Leuctridae	*Megaleuctra sierra*	G2QS?

CNDDB ranks are shorthand formulas that provide information on the rarity of a species or subspecies, both throughout its global range (G) and its range within the State (S).
G1=Extremely endangered, G2=Endangered, G3=Restricted range, rare. State Ranks S1 to S5 apply to California.
G1G3 (and S1S3)=ranks somewhere inbetween, G? or S? means insufficient data to rank,
G2QS?=species is endangered but there is some taxonomic questions.
(from Appendix 1, California Natural Diversity Database online)
*=collected in 2007 samples in Silver King Creek

Date: April 29, 2009

To:
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State Supervisor
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U.S. Fish and Wildlife Service
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From:

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and

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Re: Comments / Draft Environmental Impact Statement / Environmental Impact Report (EIS/EIR) for the Paiute Cutthroat Trout Restoration Project, Carson-Iceberg Wilderness, Humboldt-Toiyabe National Forest, Alpine County, CA. Rotenone poisoning in the Silver King Creek watershed.

We are filing these comments on this EIS/EIR as private citizens, in the public interest.

The preferred alternative in this Draft EIS/EIR is the same project that has been proposed by the Agencies ((California Department of Fish and Game (CDFG), U.S. Fish and Wildlife Service (FWS), and U.S. Forest Service (USFS)) since 2002. It is a proposal to poison streams, springs, and a lake in a California Wilderness Area for the purpose of removing non-native fish. The

EXHIBIT 5

Agencies propose to poison one or more times a year for three years with several rotenone formulations.

We have filed comments on this project at every opportunity for public comment since 2002 and in the court proceedings. We include by reference our comments previously filed (by one or both of us) with the CDFG, FWS, USFS, Lahontan Regional Water Quality Control Board (Lahontan RWQCB), the State Water Resources Control Board (State WRCB), and the court. We have subsequently also filed comments with the EPA on the use of and impacts of rotenone formulations and antimycin in streams and lakes (Erman and Erman 2005, 2006, 2007). We will not attempt to repeat here all the evidence we have already filed on this issue but will assume it is in Agencies' files and is part of the official record. If the Agencies need copies of any of the above documents, we will provide them upon request.

The fundamental questions regarding this project are as follows:

a). Are the probable losses of native, non-target species; of losses and changes to the terrestrial and aquatic food web; and changes in community composition and species assemblages worth the potential benefit of a larger population of this cutthroat trout subspecies?

b) Is there a true barrier to upstream fish migration in the Silver King Creek canyon, and if not, what will further poisoning downstream in this watershed accomplish?

c) What is the real genetic status of this trout, what was its true native habitat, and can this subspecies be identified well enough to manage it and move it around?

Question "a" is fundamental to any intentional poisoning in a Wilderness Area, National Park or any other area of special ecological signficance. Questions b and c are critical to the analysis of long-term success of the Agencies' desire to expand this population of trout and whether or not there is a good reason for the project.

We state at the outset that we are in favor of either Alternative 1, the No Action Alternative or a modified Alternative 3, Combined Physical Removal of fish. We do not support Alternative 2, the Proposed Action using rotenone poisons. We support efforts by the Agencies to remove the non-native fish, that the CDFG has stocked for decades, from as many habitats as possible. We think removal can be done in ways that do not harm non-target, native species. Alternative 2 is not such a method. Further, our analysis of the whole project and its history suggest that the objective of this particular project—to expand this population of cutthroat trout subspecies downstream—may not be possible because of physical conditions in the habitat and the Agencies' continued actions in the watershed.

The EIS/EIR produced some new information on the genetic status of the trout subspecies. It also contains contradictions, errors, and misrepresentations of past events and known science. Some relevant information has been omitted from the EIS/EIR.

We have reviewed the EIS/EIR and many of the supporting documents.

<u>Omissions in Executive Summary under 1.4 Public Involvement Summary</u>

Before discussing the merits of the project, we must make some relevant corrections/additions to the past environmental review process that have been omitted in the Executive Summary.

The CDFG issued a negative declaration on the project in 2002. Comments filed with CDFG by one of us were ignored. We asked for preparation of a joint EIS/EIR when the project was first proposed in 2002.

The current project was halted by legal action twice since 2002. First, it was withdrawn by the USFS in 2003 after legal documents were filed in US District Court to force the USFS to complete an environmental assessment (EA) on the proposed project (Case No.: Civ-S-03-1756 GEB (PAN)). At that time the Lahontan RWQCB had not issued an NPDES permit or held a hearing on the project. However, the Executive Officer of the Lahontan RWQCB had given his approval for the project.

The USFS issued a Draft EA in February, 2004. A Decision Notice and Finding of No Significant Impact (FONSI) was filed on IV-30-2004. Appeals were filed in June 2004. The USFS denied Appeals in August, 2004.

The Lahontan RWQCB held a hearing on a draft NPDES for the project in September, 2004, and declined to issue the NPDES permit. Upon appeal from the CDFG, FWS, and Trout Unlimited, the State WRCB over-ruled the Lahontan RWQCB in July, 2005, and issued an NPDES permit for the poisoning project. In August, 2005, the project was stopped by a preliminary injunction in U.S. District Court, eastern district of California (No. Civ. S-05-1633 FCD KJM) for failure of the USFS to prepare an EIS to address the concerns raised by the public and independent scientists.

We commented in detail on the FWS Draft Revised Recovery Plan for the Paiute cutthroat trout. Our comments were ignored in the final plan that was issued August 10, 2004.

<u>Impacts of Rotenone Formulations on Non-Target Species</u>

<u>Aquatic Invertebrates</u>:

We told CDFG (and the Lahontan RWQCB) as early as 1994 (Erman 1994) that they should conduct species-level inventories of aquatic invertebrates prior to poisoning lakes and streams. We reiterated the need for species inventories to the Agencies in 2002. We presented information during court proceedings on how this could be done reasonably. In the present document the Agencies claim that such species inventories are "infeasible" to conduct and anyway they know that no rare or endemic species have been found ("No benthic invertebrate species strictly endemic to the Silver King Creek Watershed have been identified." (5.1-26 2nd para. under Rare and Endemic species). So, in other words their logic is, "if we don't look for them, we won't find them and so, therefore, they don't exist."

But in another part of the document we find this sentence:
"In conclusion because the treatment could result in loss of rare or endemic species, this would be a significant and unavoidable impact" (p. 5.1-46). This conclusion seems strange in a project that is being proposed to "save" a "species" of fish. (In a later section we will discuss the use of "species" as it applies to the Paiute cutthroat trout.)

We contrast the statements in this document with earlier wording by CDFG in the Final Programmatic EIR (subsequent) for Rotenone Use for Fisheries Management, July 1994.

> "CDFG personnel are currently involved in a multi-year study of the effects of rotenone on macroinvertebrates from the Silver King Creek drainage (Alpine County). This study involves the identification of invertebrates <u>at the species level</u> prior to, during and for three years after scheduled treatments." (p. 103, Final Programmatic EIR (subsequent) on Rotenone Use. (July 1994). (Our emphasis added).

We later analyzed the data from the studies referred to above (Trumbo et al., 2000a and Trumbo et al., 2000b). We found that only larval specimens had been collected and that no species level studies had been done. The agencies have now had 19 years to do the species level studies they claimed they had been doing in the 1994 CDFG Programmatic EIR. That is more than enough time to do several species level studies in several watersheds.

Further, contrary to statements made by CDFG in correspondence with the Lahontan RWQCB, long-term significant impacts had occurred in aquatic invertebrate composition following poisoning of upper parts of the Silver King stream system from 1991 to 1993. We presented results of our analyses to the Lahontan RWQCB, State WRCB, USFS, FWS, the court, and more recently to the EPA. The findings are summarized in Erman and Erman 2006 (Exhibit A). We included in that summary the direct statements from the original Mangum Reports on Silver King Creek stating how many invertebrate taxa were still missing at the end of the study. We also included a literature review of other studies showing impacts to macroinvertebrates from rotenone poisoning.

The EPA (2006) corroborated our evidence of long-term impacts in their review of our material and that of others:

> "Despite the fact that invertebrates are less conspicuous members of the aquatic community, they are a major component of aquatic ecosystems and food webs. Any significant effects on invertebrates would most likely influence other components of the ecosystem. Effects may not be limited to merely a change in total biomass as a result of widespread mortality but any changes associated with differential sensitivity could bring about significant changes in the community structure, which could alter system function (p.5)."

> "The ecological risk assessment of rotenone states that aquatic macroinvertebrates exhibit roughly similar sensitivity to rotenone as do fish, that it is likely that most if not all fish and macroinvertebrates will be killed in the targeted treatment area, and that the entire aquatic food chain can be affected. The expectation is that treated streams/lakes will repopulate through immigration and/or restocking. Whether species density/richness is identical to pretreatment conditions is uncertain; however, EFED concurs with the Ermans that it is possible that more tolerant species can potentially displace those less tolerant to rotenone if rotenone is repeatedly applied (p. 6)."

> "Whether chemical means of manipulation should be used over other mechanical control measures or to what extent other species should be sacrificed to aid in the recovery of endangered species are important questions which the Ermans raise; however, the answers involve policy issues and are beyond the scope of screening-level risk assessment (p. 6)."

"The chapter [on risk assessment] states that although the lowest toxicity value for freshwater invertebrates (48-hr EC50=3.7 μg/L) was chosen for risk assessment purposes, it is likely that more sensitive invertebrates could be found in the wild (p. 5)."

Dr. David Herbst had also reviewed the Trumbo et al. (2000 a, b) reports and found significant impacts to non-target invertebrates (Herbst 2002, Exhibit B).

The Lahontan RWQCB stated the need for a species inventory of non-target species prior to commencement of the project. They acknowledged and are aware that short- and long-term impacts occurred on the aquatic community composition during the last poisoning of the Silver King Creek basin (Harold Singer letter to Robert Williams, July 3, 2006, Exhibit C).

The Agencies have now had many years to conduct species level aquatic invertebrate studies. They are ambiguous in their responses to the issue: on one hand claiming that they are or have been conducting such studies; on the other hand claiming that it can not be done and is too difficult (5.1-26, 5.1 27). And further the EIS/EIR makes the argument that even if there were rare or endemic species present in the past, they may have already been lost because of previous poisonings (5.1-46). While we agree with this last possibility, it seems to us even more reason not to poison the remaining previously unpoisoned stream sections. We find it astonishing that the Agencies would use the possibility that they have already destroyed species in a Wilderness Area as an argument for further destruction.

We previously have explained in detail how and why adult invertebrate specimens must be collected to determine the species of most aquatic invertebrates. The confusion shown by the Agencies about what the term "species" means for the both fish and invertebrates is almost beyond belief. We assume they are purposely trying to confuse the issue to the public and other reviewers.

The Mangum lab (Provo, Utah USFS lab, no longer in operation) identified larval forms, not adults. That government lab did not, in general deal with adult specimens that could be identified to the species level. It was a biomonitoring laboratory established to see patterns at more general taxonomic levels such as genus, family, order, and class. We note that the Vinson and Vinson (2007) study that was conducted on aquatic invertebrates from 2003 to 2006 was also a study of immature larval forms and more general taxonomic levels. Therefore, many of the statements made in the section of the EIS/EIR on special status macroinvertebrates and rare and endemic species must be disregarded.

For example, the statement that "Vinson and Vinson provide the species list for both historic and recent data"(EIS 5.1-27) is false. There is no species list for any of these studies. The Agencies know this and have stated it on the previous page (5.1-26). Vinson and Vinson acknowledge this in their report as follows: "The collection of adult insects would greatly facilitate our knowledge of species present in the Silver King Basin, which would assist in the routine identification of larval insects" (Vinson and Vinson 2007, p. 68).

The Vinson and Vinson study includes a review of literature on rotenone impacts to non-target species. In their original report they conclude the following:

> "The results of three longer-term more intensively sampled studies in mountain streams suggest that common taxa will quickly recolonize treated areas and rarer taxa may be eradicated for a number of years or potentially forever."(Vinson and Vinson, Summary, p. x).
>
> They also state "This suggests that rotenone impacts to invertebrates will be greatest in mountain streams characterized by cold water and high oxygen levels as these streams are characteristically dominated by small gilled invertebrates, namely Ephemeroptera, Plecoptera, and Trichoptera" (p. 13,14).

The stated purpose of the Vinson and Vinson report was "to evaluate the effects of previous rotenone treatments on aquatic invertebrate assemblages in the Silver King Basin." We, like Vinson and Vinson (p.xiii, #5), found the data unsuitable for such an evaluation. There were too many variables to make a comparison with the earlier studies (1990–1996). Samplers used were different (a modified Winget Surber sampler vs. a standard Surber sampler), mesh sizes were different (0.280mm vs. 0.5mm). The stations had been changed, the number of stations were not the same. The control stations were different. Thus, local stream conditions (microhabitats) could not be accounted for. Vinson and Vinson analyzed the data but apparently did not do the sampling. There was no information on who collected the samples. We assume the people doing the sampling were different in both studies and may have been different from one date to the next, thereby introducing another source of variation. Sampling protocols were different. Stratified random samples were collected in the 1991-96 study, while three samples in a single riffle were collected in the 2002-2006 study. And, finally, the samples were analyzed in different laboratories with different protocols. The Provo, Utah USFS lab subsampled in the laboratory; the Utah State BLM lab counted all individuals in the sample.

No credible scientific comparison could or should be made between these studies. The first principle of replication of a study is to use the same methods.

In addition, we found some major errors in understanding what has and has not been poisoned previously in the Silver King watershed. The Agencies need to get their stories straight on this question. New information appears in the Vinson and Vinson report that claims Silver King Creek below Lewellyn Falls had been previously poisoned. This claim is contrary to information in the earlier EA and to testimony given before the Lahontan RWQCB. The information is attributed to Finlayson, personal communication (Table 3, p. 23, Vinson and Vinson 2007). Either the CDFG poisoned this stream section illegally or the Vinson and Vinson report has made an error that would invalidate the results of their analyses: What is a treatment and what is a control (i.e., non-poisoned) station?

Also, Vinson and Vinson state that one of the two stations on Bull Canyon Creek is a control station (Table 4, Vinson and Vinson 2007). This station is clearly below the junction with the mouth of Whitecliff Lake which, according to Ryan and Nicola (1976) was poisoned to remove "heavily spotted trout" in an earlier project and was also poisoned in the 1991-93 project (Flint, et al., 1998). Again, if invertebrate sampling stations were not controls but were considered such, and visa versa, no data analyses would be valid.

It seems that Vinson and Vinson made a major error in data conversion of the earlier Mangum data. The Mangum data were already given in numbers/m^2 and Vinson and Vinson multiplied those numbers by 0.279 and presented them as m^2 in their tables.

The Vinson and Vinson analyses were made at so general a taxonomic level it would not be possible to see differences between treatments and controls. Our analyses of the Trumbo et al. (2000 a, b) reports found impacts to aquatic invertebrates three years after the final poisoning in Silver King Creek for a total of, at least, six years of impacts. Invertebrate sampling was discontinued by the Agencies three years following the poisoning in Silver King Creek. In another nearby watershed, Silver Creek, major impacts were evident two years following final poisoning for a total of five years of impact. It is unclear why the Lahontan RWQCB only required three years of follow-up study in the case of Silver King Creek and two years of follow-up study in Silver Creek. In both cases impacts were still evident at the time the studies were ended (Erman and Erman 2006, Exhibit A). Both studies showed significant long-term impacts to macroinvertebrates including decreases in species diversity, decreases in number of taxa, decreases in number of stoneflies and major reductions in the stonefly family Peltoperlidae, the most abundant stonefly group prior to poisoning.

In 2003, CDFG provided the Lahontan RWQCB staff the following statement: "No evidence of long-term impacts were found in either study" (Interagency Study Proposal, LRWQCB files, June 15, 2003, Evaluation of Rotenone use in Silver King Basin on Aquatic Macroinvertebrates, 2003-2007).

The Antidegradation Policy of the Clean Water Act states that "where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected"(Code of Federal Regulations, Title 40, Sec. 131.12). The Lahontan RWQCB considers water quality of Silver King Creek to be "exceptional" (p. 5.4-3, EIS/EIR).

The Water Quality Standards Handbook (4.7) outlines specific requirements for ONRWs ((40 CFR 131.12(a)(3)). "ONRWs are provided the highest level of protection under the antidegradation policy." "The regulation requires water quality to be maintained and protected in ONRWs." "ONRWs are often regarded as the highest quality waters of the United States. The regulation "permits States to allow some limited activities that result in temporary and short-term changes in the water quality of ONRW. Such activities must not permanently degrade water quality or result in water quality lower than that necessary to protect the existing uses in the ONRW. It is difficult to give an exact definition of 'temporary' and 'short-term' because of the variety of activities that might be considered. However, in rather broad terms, <u>EPA's view of temporary is weeks and months, not years.</u>" (Our emphasis added)

The antidegradation policy further states for all water bodies, even those without ONRW status, that "species that are in the water body and which are consistent with the designated use (i.e., not aberrational) must be protected, even if not prevalent in number or importance. Nor can activity be allowed which would render the species unfit for maintaining the use. Water quality should be such that it results in no mortality and no significant growth or reproductive impairment of resident species" (Water Quality Standards Handbook, Appendix I-3, 4.9.2.2). And these protections hold for all existing aquatic life whether or not a water body supports fish.

In Chapter 5 the EIS/EIR states "Similarly, the Federal Antidegradation Policy, Title 40 C.F.R. section 131.12, dictates that water quality shall be preserved unless deterioration is necessary to accommodate important economic or social development." (p. 5.4-14) Federal policy, however, does not end with this paraphrase of the Antidegradation Policy. The next sentence from Title 40 CFR, section 131.12, part a (2) is "In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully." (our emphasis added).

Food Web Impacts and Terrestrial and Aquatic Species:

The importance of aquatic invertebrates to the food webs of aquatic and riparian species in the Sierra Nevada was discussed in detail in Erman 1996. Insects are food for other larger insects, fish, and amphibians in the water, and emerging adult insects are a major source of food for many terrestrial insects, spiders, birds, amphibians, reptiles, and mammals including bats (e.g., Nakano and Murakami 2001; Sanzone, et al., 2003; Ballinger and Lake 2006; and Pope, et al., 2009). The loss of large portions of emerging insects for several years during and following poisoning of miles of stream and a lake would be a major impact to riparian animals.

No list of terrestrial species for the Silver King basin has been provided in the EIS/EIR, but species of concern (e.g., yellow warbler, willow flycatcher) are mentioned as feeding on emerging aquatic insects. The impacts of food loss to these species are dismissed, apparently with no data to support the opinion of the Agencies.

Major poisoning disturbances cause changes in quality and quantity of invertebrate assemblages. These changes in turn cause changes in the emergent insect food supply and alter available invertebrate food in not only the aquatic habitat but also the terrestrial environment. To reiterate an earlier EPA (2006) statement, "...any changes associated with differential sensitivity could bring about significant changes in the community structure, which could alter system function."

A particularly noticeable omission in the EIS and the FWS Revised Recovery Plan for the Paiute CT is that no food habit studies have been conducted for the fish. The Agencies do not know what invertebrates are the preferred food of the Paiute CT. Neverthless, they are planning to poison the food supply of the very fish they are attempting to "save."

Other considerations regarding aquatic invertebrates:

The Agencies have assumed that upstream species will recolonize downstream areas after poisoning events or that species will fly upstream (EIS, 5.1-19). While this may be true for some species, it will not be true for all or even most species. Macroinvertebrate species, as most animal species, occupy specific habitats. Some species have narrow habitat requirements and are locally distributed along a stream gradient. Other species are generalists and can live in a wide diversity of habitats.

In studies on small streams in the Sagehen Creek basin, eastern Sierra Nevada, similarity of caddisfly species composition was only 38% between the spring source and a site 270 meters downstream, and the species similarity at 470 meters downstream from the spring source had decreased to 20% (Erman 1996).

Species that are generalists, commonly called "weedy" species, may return in high numbers following a poisoning event. Dispersal mechanisms vary by species and some species actively disperse only a few meters (Erman 1984, Sode and Wiberg-Larsen 1993). More restricted species may never return to the area following poisoning. Studies in Denmark at the species level have found aquatic invertebrate species missing up to 40 years following poisoning with insecticides or severe organic pollution (Sode and Wiberg-Larsen 1993).

The Agencies have an incomplete and incorrect understanding of the "EPT index" that they like to use in biomonitoring. The absolute and relative abundance of mayflies, stoneflies and caddisflies do not necessarily mean a healthy stream system as implied in the EIS. For a discussion of the limitations and cautions of broad taxa monitoring see Erman 1996. High numbers of generalists (including species of EPT) can mean disturbed systems. Here, again, species identification can be critical.

Monitoring must answer the questions that are asked by the treatment. In the case of poisoning, the questions are how will poisoning change the non-target species assemblages and will species disappear or be reduced over the long-term. General indices like an EPT index, which is at the taxonomic level of order, can not answer the question. Some species will return after even the most drastic disturbances in aquatic systems. The question is not, will something return, or will the same orders of insects return, or will some class of invertebrates return; but rather, will the same species return in the same numbers and proportions? The gross level of analyses conducted by the Agencies did not ask or answer the relevant questions for this proposed project.

Undisturbed streams in relatively pristine habitats show stability of macroinvertebrate populations from year to year making them excellent references for use in long-term biomonitoring programs (Erman 1989; Robinson et al., 2000).

Amphibians:

The mountain yellow-legged frog was present in abundance in the Silver King basin in 1993. Several thousand were seen along the shores of Whitecliff Lake. They were also found in Upper Fish Valley and near the confluence with Fly Valley Creek (USFS EA 2004). The present EIS/EIR states "although this species (yellow-legged frog) could occur in the proposed project area, it has not been documented in recent surveys (2001 to present); thus the potential for its occurrence would be low." But then it goes on to state that the Agencies have been relocating juvenile amphibians "to outside the proposed project area" (5.3-11, 12). When and for how long have the Agencies been relocating "juvenile amphibians?" Because it would be impossible to relocate all or even most of the tadpoles or frogs or toads in the area, this reason for claiming poisoning will not affect them is unacceptable. Poisoning their habitat will kill yellow-legged frogs, tadpoles and adults, and possibly immature Yosemite toads, and it will surely reduce and/or eliminate the food of adults.

As of October 16, 2008, the EPA has made a "May Affect" and "Likely to Adversely Affect" determination for the California red-legged frog (CRLF) from the use of rotenone as a piscicide. The EPA has also determined that there is the potential for modification of CRLF designated critical habitat from the use of rotenone as a piscicide. "Indirect effects to the CRLF may also occur through the loss of both vertebrate and invertebrate aquatic forage items." (EPA webite)

The same impacts of rotenone would be expected to occur directly on the mountain yellow-legged frog and its food web.

Other Sensitive Fish in Silver King Creek:

The EIS/EIR has reported no sensitive species of fish other than Paiute CT in the proposed project area. We suggest the Agencies look more closely in the reach of Silver King Creek below Snodgrass Creek (the area within the travel time of potassium permanganate and residual rotenone). According to the California Natural Diversity Database list of Special Animals, the mountain sucker (*Catostomus platyrhynchus*) is on the list of sensitive fish species. Although not collected in the sample station immediately above Snodgrass Creek on Silver King Creek, the next station downstream is on the E. Fork Carson River just above the junction of Wolf Creek. This station does contain mountain sucker (Deinstadt et al. 2004). The EIS/EIR should also reveal that within the main project area, the poison will eliminate native Lahontan basin populations of Paiute sculpin (*Cottus beldingi*) and mountain whitefish (*Prosopium williamsoni*) known to exist in the reach above Snodgrass Creek (Deinstadt et al. 2004).

Springs, Their Protection, and Implications of Climate Change

Our research has revealed rare, endemic, and relict species of invertebrates in many springs, seeps, and headwater streams in the Sierra Nevada (e.g., Erman, 1981, 1984, 1989, 1992, 1997, 1998; Erman and Erman 1990, 1995; Erman and Nagano 1992, Wiggins and Erman 1987). The constant temperature in many seeps and springs makes them habitats for species that were more widespread in the past during different climate conditions, some warmer, some colder. Springs, therefore, are refuges or repositories for species that may expand or shrink their ranges as temperatures change in the future. As such they should receive special protection from resource management agencies. But we find no such consideration for these habitats in this EIS.

The preferred alternative plans to poison springs and seeps (e.g., p. 3-3, 3-8, B-22, p. 5.3-1, p. 5.3-11, C-4), but the EIS (5.1-19) cites Erman (1996) for evidence of endemics in springs. And later, the EIS/EIR states "Endemic species are more likely to occur in small, isolated habitats, such as springs. However, no endemic macroinvertebrate species have been found to date in Silver King Creek Watershed (p. 5.1-21)." Again, we emphasize that no species level studies have been conducted by the Agencies in springs, seeps, or any other aquatic habitats in the Silver King basin, and so they have no scientific basis for this statement. And no studies of any kind have been done on aquatic invertebrates in springs, seeps, or Tamarack Lake so far as we are aware.

A Memorandum of Understanding was signed in 1999 by the Bureau of Land Management, the FWS, the National Park Service, the U.S. Geological Survey, the USFS, the Smithsonian Institution, and the Nature Conservancy for conservation of springsnails and their habitats, to protect sites and avoid the need to list species of springsnails pursuant to the Endangered Species Act. How has that MOU been followed in this EIS?

Inadequate Evaluation of Global Warming and Added Stress of Poisoning

Global warming is already causing changes in species composition of lakes and streams (e.g., Burgmer et al., 2007, Durance and Ormerod 2007). Experimental manipulation of first-order streams has shown varied and unpredictable responses in a suite of invertebrate taxa and species (Hogg and Williams 1996). In our studies of springs before, during, and following drought in the Sierra we found that springs with rising temperatures during droughts had lower numbers of Trichoptera species (Erman and Erman 1992, 1995). The added stress of poisoning can only exacerbate species losses and changes occurring at higher elevations because of climate change.

Absence of Impermeable Barrier to Upstream Movement of Non-native Fish

The existence of a natural, absolute barrier in the Silver King Creek Canyon is critical to the successful permanent removal of unwanted fish in Silver King Creek below Llewellyn Falls. No such barrier exists, in our opinion. The EIS/EIR cites Heise 2000 as the authority for their opinion that there is a real barrier (5.1-9). A reference to Heise is not present in the References cited at the end of this chapter. We assume this reference is to a memorandum that was produced by the Agencies during court proceedings in 2005 (Exhibit D). In this memo Mr. Heise gives his opinion on the falls in lower Silver King Canyon. He states that he only observed the area during low flow and that while he thinks it could be a barrier to fish migration there is a "remote chance" that it is not. He states, however that "a vertical fall of eight feet may be reduced to two or three feet when the stream rises to flood levels. Evidence of high flow at the subject barrier site suggests that the flood flows could be four to six feet or more in depth."

Rainbow/steelhead trout have the greatest capacity for leaping falls of any migratory salmonid. They can leap about 3.3 m (10.8 ft.) vertically or slightly less than 3 m (9.8 ft.) while extending about 3 m (9.8 ft) horizontally (Reiser et al., 2006). Thus, passing the vertical falls present in Silver King Canyon even at low flow seems within the range of large rainbow trout. It seems likely that large Lahontan cutthroat trout could also pass these falls and may have in the past.

Without physical measurements, statements about barriers become merely subjective argument. Scientific judgement of potential barriers should be based on accurate data on

1) difference in surface elevation between the upstream water surface and the plunge pool,
2) the horizontal distance from the fall's crest to the plunge pool, and
3) the leaping characteristics of the pertinent fish species (Powers and Orsborn 1985, Reiser et al., 2006).

Further, these data should be obtained at a range of stream flows in order to establish a rating curve of changes in fall distance and other features (Reiser et al., 2006).

Attached to the copy of the Heise memorandum was a handwritten sheet, titled Barrier Costs, calculating the cost of building fish barriers in the Kern River basin (for golden trout management) and in the Silver King Creek Canyon. It seems the CDFG suspected in 2000 that they may not have a natural barrier in Silver King Canyon. The sorry pattern of poisoning streams repeatedly and then learning that there is no barrier to upstream fish migration has already been tried in the Golden Trout Wilderness. Is it a contingency plan of the Agencies to begin poisoning and then argue for constuction of a barrier (estimated in this 2000 memo at a cost of 1.5 million dollars) later, in a Wilderness Area, as they have done in the Golden Trout Wilderness where so many costly mistakes have been made in fish management? The possible barrier construction discussed at p. 3-14 in the EIS does not sound like the same barrier Heise was referring to in his memo.

Fishing in Silver King Creek

The EIS/EIR has frequently raised the specter of someone moving hybrid or non-pure PCT above existing fish barriers, especially Llewellyn Falls. "Introduced trout pose the greatest risk to the species."and ...."the threat of humans moving other trout species into these protected reaches continues. An ill intentioned angler could easily catch a rainbow trout and release it above Llewellyn Falls, involving a transport of the fish only a few hundred feet. This action would unravel decades of restoration efforts and place the populations of Paiute cutthroat trout in Upper Fish Valley and Four Mile Canyon Creeks at risk" (p. 5.1-11 EIS/EIR).

And further, "Llewellyn Falls is easily accessed by the public, which could lead to rogue or inadvertent transfer of hybridized fish to areas above the falls" (p. C-2).

If anglers are the problem, why has fishing been continued and promoted in Silver King Creek? Fishing was stimulated below the falls even during the period of the last poisoning project from 1991-1993, for example, the EIS states: "… during 1991, approximately 800 rainbow-Paiute cutthroat hybrids were collected by electrofishing and stocked into Lower Fish Valley and Tamarack Lake using a helicopter. These non-native trout hybrids provided good fishing for anglers during the early and mid-1990s" (p. 5.1-16). The section open to fishing extends upstream to Tamarack Lake Creek, above the junction of Coyote and Corral Creeks and their "secure" pure populations of Paiute cutthroat trout. Fishing was continued up to the last request for closure of Silver King Creek in 2005, and then the Agencies asked the California Fish and Game Commission to withdraw the closure in 2006 after the federal court blocked the project. Recently, the Agencies asked the Fish and Game Commission to increase the allowable daily take from 5 to 10 fish (p. 3-3). That request was finalized by the Commission on April 9, 2009. The request was made specifically to increase the removal of fish from the project area. These actions belie the Agencies' concerns for the threat of anglers moving fish.

The other "most important" threat to continued survival of Paiute cutthroat trout is said to be the existing small, isolated fragmented populations. So, on one hand, isolated populations are a threat; yet on the other hand, they provide a margin of safety from "ill intentioned anglers" or other "catastrophic events." However, if the proposed Action is conducted, the entire 11 miles of connected stream habitat would become fully exposed to "rogue transfer" from below Snodgrass Creek or to other, imagined catastrophes. In other words, expanding the population downstream in no way lessens the threat of "rogue transfer."

The Agencies are now trying to remove themselves from analysis of implications of a future fishery for Paiute CT as part of the Heritage Trout Fishing Program, claiming it is a decision for the California Fish and Game Commission (e.g., p. 5.1-30, 5.6-9) and "not part of the proposed Action (or its alternatives) which focuses on restoration of the species" (p. 5.1-30). Others in the CDFG, however, have written: "The planned addition of a catch-and-release Paiute cutthroat trout fishery below Llewellyn Falls, which is conditioned on removal of the existing trout population, will provide a unique opportunity" (p. 113, Deinstadt et al., 2004).

And earlier, "By the summer of 1973, following a year of discussions and meetings both within the Department of Fish and Game and between the Department and the U.S. Forest Service, it was finally decided that restoration of pure Paiute cutthroat in the mainstream above Llewellyn Falls would be attempted..." and "It was further decided that restoration of pure Paiute cutthroats would be extended to all of Silver King Creek and its tributaries above Silver King Canyon" (p. 38, Ryan and Nicola, 1976).

Nevertheless, in the 1985 FWS Recovery Plan (U.S. Fish and Wildlife Service 1985) the Paiute CT would be considered recovered "when a pure population of Paiute CT has been reestablished in Silver King Creek above Llewellyn Falls." That objective has been met.

The EIS/EIR is inadequate because it has highlighted the continuing threat from anglers moving fish, yet has not evaluated the sport fishery being planned to follow removal of hybrid fish from the proposed areas or the current newly expanded fishery above Silver King Creek canyon.

Agencies Moving Hybrid Fish in Wilderness Areas

Prior to the 1991 poisoning of the Upper Silver King basin hybrid fish were captured and moved to other places in the Wilderness Area (Tamarack Lake and Poison Lake) and in the east Carson drainage (Ryan as cited in Schaffer 1992). Moving hybrid fish to other areas in the Wilderness Area was apparently still occurring as recently as 2004, according to the Trout Unlimited website, August 3, 2004. If the Agencies have so much trouble with hybrid fish polluting Lahontan CTs and Paiute CTs, why have they been expanding the populations of hybrid fish anywhere, let alone in a Wilderness Area and in the same major drainage, the East Carson River, where they think they have pure populations of Lahontan CTs and Paiute CTs? And why has it been CDFG policy for so long to move unwanted hybrid fish, or for that matter non-native fish of any kind, to other areas in a Wilderness Area without any environmental analysis or recognition that this is a form of biological pollution? "Ill-intentioned anglers" and "rogue transfer" of fish are not the only, or even the major agents, of non-native fish pollution in the Sierra.

We previously raised our concerns about the transport of salvaged hybrid fish into the Poison Creek drainage where pure Lahontan cutthroat trout were said to live (Deinstadt et al., 2004). In the EIS/EIR, a small tributary of Silver King Creek is now labeled "Poison Flat" (Fig. 1-1). Deinstadt et al. states, "Poison Flat Creek is a northern fork of Poison Creek and is not named on maps. Because of its close proximity to Poison Flat it is informally called Poison Flat Creek" (p. 109). Several references to the unnamed tributary of Silver King Creek refer in the EIS/EIR to Poison Flat (e.g., p. 3-4, 5.2-13, 5.4-1). We suggest that the EIS/EIR avoid references to the tributary of Silver King Creek in any way as "Poison Flat" so that confusion in future stocking, fishing, or surveys will be avoided.

<u>Other Catastrophes</u>

The EIS/EIR frequently mentions the risks of extinction from low frequency, large events, e.g., flood and fire. These risks are overblown. In one place (p. 5.1-2, EIS/EIR), occasional floods, forest fires, and drought help create a "...mosaic of patchy, dynamic habitats that support diverse and resilient communities of aquatic and terrestrial flora and fauna." But later in the EIS/EIR: "Due to the small and restricted populations that continue to face threats from catastrophic events such as floods, fire, and non-native fish populations..." (p. 5.1-8), and "...remaining Paiute cutthroat trout populations are vulnerable to extinction through stochastic factors such as ... catastrophic events such as floods and fire..." (p. 5.1-12).

The Paiute cutthroat survived, presumably, over the many years of its existence, in the face of naturally occurring fire and flood when it was confined to a much smaller habitat than it currently occupies. Fish surveyors in the Silver King Creek watershed point out that "Effects of the 1997 flood were not evident from the Four Mile Canyon Paiute cutthroat trout populations or our observations" (p. 108, Deinstadt et al. 2004). This flood was the largest in the 87 years of record for the closest USGS gaging station, the W. Carson River at Woodfords.

Other long-term studies in the eastern Sierra Nevada have shown the persistence and resilience of Lahontan Basin fishes under the natural regime of floods and drought (Erman 1986, Erman et al., 1988).

Risks of large fires are lowest at the highest elevations (such as the Silver King Creek basin) of the Sierra Nevada and especially so in remote locations where attempts at fire suppression and hence fuel build up are minimal (McKelvey et al., 1996).

Taxonomic status of Paiute Cuttroat Trout

For the first time, we learned in this EIS/EIR that the Paiute cutthroat trout, *Oncorhynchus clarki seleniris*, (Paiute CT) can not be separated visually in the hand from hybrids of it with rainbow trout, *Oncorhynchus mykiss*; golden trout, *Oncorhynchus mykiss aguabonita*; and Lahontan cutthroat trout, *Oncorhynchus clarki henshawi* (Lahontan CT). We also learned in the EIS that genetic markers have not yet been found to separate the Paiute CT from the Lahontan CT.

We commented previously on the subject of genetic composition of the fish in Silver King Creek and cautioned against moving or poisoning fish before key questions were resolved. Now, again, the Agencies want to push ahead with "restoration" before they know the answer to a fundamental question of the "purity" of Paiute cutthroat trout populations. Lahontan CT have been present in Silver King Creek prior to any attempts at Paiute CT recovery (Ryan and Nicola 1976). And yet, the Agencies still cannot say either that there is any genetic difference between a Lahontan cutthroat and a Paiute cutthroat or whether or not Paiute cutthroat populations are hybrids of the two. The final sentence from the paper by Cordes et al. (2004) is critical: "Additionally, the development of molecular markers that can distinguish between LCT and PCT would be important for determining their genetic relationship and investigating the possibility of introgressive hybridization between the two groups prior to any restorations." (p. 116, our emphasis added).

More recent genetic studies (Finger et al., 2008) plus the summaries in the Draft EIS/EIR support our earlier misgivings about any project going forward. These findings are as follows:

1. In both a report to the USFS and CDFG (Israel et al., 2002) and the subsequent published paper (Cordes et al., 2004) researchers found no way to

separate Paiute cutthroat trout from Lahontan cutthroat trout by the means they used to identify hybrids.

2. The most recent genetic study by Finger et al. (2008) developed more methods of separating and distinguishing "pure" and hybrid trout from Silver King Creek. This study developed single nucleotide polymorphism markers (SNPs) that are said to be quick, inexpensive, and effective for characterizing introgressed populations and to improve on past molecular markers that "...are costly, time consuming, and often are not diagnostic for distinguishing between *O. mykiss* and *O. clarkii*."(Finger et al., 2008, p. 4). Nevertheless, although the new methods could distinguish between subspecies of *O. mykiss* (i.e., between rainbow and golden trout subspecies) and between rainbow and cutthroat trout, the SNPs could not separate or distinguish between subspecies of cutthroat trout (*O. clarkii*) (i.e., between Paiute and Lahontan cutthroat trout).

3. The Draft EIS/EIR points out in several places (e.g., p. 5.1-34, 5.1-48) that Paiute CTs cannot be distinguished from hybrids in the field: "There is no practical way to identify or separate, in situ, potentially pure Paiute cutthroat trout from hybrid individuals in treated areas."

We wonder, then, how Paiute CT can be separated and restocked after rainbows, Lahontans, and hybrids are removed from the area. We also wonder what the CDFG has been moving around and calling Paiute CT if they can not separate it visually.

The Agencies have moved Paiute CTs into several other areas where it was not native, and so there are now four or five other populations of it in other streamsheds. In the Silver King Creek basin there are now six separated populations of the Paiute CT in part because the Agencies purposely enhanced barriers on some of the smaller streams to separate the fish. Now they claim the isolated populations are a threat to the survival of the fish (see following section on Fragmentation).

Furthermore, there are conflicting opinions among scientists in the published literature about the origin and age of this subspecies. Is it an old form (J. H. Ryan in Schaffer 1992, Nielsen and Sage 2002) or a relatively recent form (Behnke and Zarn 1976), in evolutionary terms? Or is it perhaps an even more recent color variation that developed in a population of Lahontan CT, that were moved over maybe the last 120 or fewer years?

Ryan reported that the native habitat of the Paiute CT was above Llewellyn Falls (J. H. Ryan in Schaffer 1992). The type locality for the subspecies is above Llewellyn Falls, that is, the location where the specimens were first collected and subsequently described by Snyder in 1933. The Agencies have rather recently decided, with no scientific evidence, that the native habitat was below Llewellyn Falls.

Fragmentation of Existing Populations of Paiute CT

The EIS/EIR has built a case for expanding the range of PCT below Llewellyn Falls partly based on the fragmented character of existing populations within and outside the Silver King Creek basin. It cites references that claim minimum stream lengths needed to save a species. "Given the current literature in trout population ecology, the existing small isolated populations of Paiute cutthroat trout are not large enough to sustain the subspecies in the long term" (p. 5.1-12 EIS/EIR). The Agencies have not fully acknowledged (p. 5.1-2) that some of the present fragmentation in Silver King Creek is from their own actions and could be undone.

If more connectedness is important, the EIS/EIR should consider actions that would expand connectedness of existing populations in addition to moving fish among populations. Within the upper mainstem of Silver King Creek above Llewellyn Falls, there are now 2.7 miles of stream without barriers (Table 5.1-7). Prior to construction in 1972 of an artificial barrier by the Agencies (p. 5.1-2 EIS/EIR), Four Mile Canyon Creek (1.9 miles) had only a 2 ft falls that was not a fish barrier. "With the cooperation and assistance of the Toiyabe National Forest personnel, an artificial barrier was constructed in 1972 on a natural falls about 0.6 m (2 ft.) high, situated between several large granite boulders approximately 0.4 km (1/4 mi.) upstream from the mouth" (p. 36, Ryan and Nicola 1976).

In addition, the Agencies have likely enhanced or altered barriers on Bull Canyon Creek (0.6 miles). "The 1975 survey, however, revealed that heavily spotted fish were present upstream as far as the mouth of Whitecliff Lake Creek. An inspection of the barrier site revealed that the stream had bypassed the natural barrier" (p. 43, Ryan and Nicola 1976). Thus, it would be possible to redirect Bull Canyon Creek around the existing barrier as naturally occurred in the past and remove the artificial barrier on Four Mile Canyon Creek, thereby restoring an additional 2.5 miles to the existing 2.7 miles on Silver King Creek for a total of 5.2 miles. Removal of these artificial barriers would nearly double the distance of interconnected stream and restore the streams to a natural state.

Missing basic life history information and characteristics of Paiute CT

For all of the Agencies' professed concerns for the threatened Paiute CT over the past more than 40 years, they have failed to obtain some of the most basic biological information about the fish. We brought to the attention of the FWS five years ago many gaps in data, and the information is still missing in the EIS as follows:

1. No data on food habits of fish from Silver King Creek, and yet, the Agencies are ready to poison out the native invertebrates in the "native" habitat of the fish.
2. No data on age and growth except from fish transplanted to the North Fork Cottonwood Creek a non-native habitat.
3. No data since 1956 when Ryan and Nicola (1976) reported on ages of 40 fish from Silver King Creek.

4. No data in last 53 years on length at age for fish from Silver King Creek.
5. No data on length – frequency for populations in Silver King Creek.
6. No data on when fish reach sexual maturity in Silver King Creek and, therefore, whether 150 mm (the standard size CDFG considers "catchable" or adult trout) as the rule for "adult" makes any sense.
7. No data on fecundity of fish in Silver King Creek.
8. No data on any differences in age/growth/sexual maturity by sex (even though typically trout males mature a year earlier than females).
9. No data to support or refute that there are assumed (by FWS in Revised Recovery Plan) to be only three age classes of PCT in Silver King Creek.
10. No current field data on age class composition in the EIS/EIR although the Revised Recovery Plan said it would "now" (as of 2004) begin "to monitor abundance and age class composition." (Have they?)
11. No data on microhabitat (e.g., depth, velocity, substrate) preferences.
12. No data on meristic characteristics of PCT (e.g., pyloric ceaca, gill rakers, basibranchial teeth, scale counts) since Behnke and Zarn (1976) examined Snyder's original 1933 collections.
13. No data (as listed above) on any of the out-of-basin populations except NF Cottonwood Creek collected in the early 1970s.

Errors in Estimate of Number of Fish

We think the values presented in the EIS/EIR (p. 5.1-9) for the number of fish in Upper Silver King Creek and the other tributaries are far too low. The EIS/EIR states: "Approximately 1,020 adult Paiute cutthroat trout reside in the Silver King Creek drainage, based on CDFG population assessments in 2001 (FWS 2004). CDFG estimated approximately 424 fish in Upper Silver King Creek above Llewellyn Falls, and an effective population size of 400-700 fish in Four Mile Canyon, Fly Valley and Corral Valley Creeks combined" (p. 5.1-9).

Shown below are the values we computed from FWS (2004) data given as 2000 and 2001 CDFG estimates (which in nearly all cases were lower than the multi-year average). Data for Coyote Valley Creek are the mean of the two test sections. Data for Bull Canyon Creek are from Deinstadt et al. (2004).

Stream	Adult/mile	Habitat in Miles	Total Adults (> 150mm)
Upper Silver King Ck.	353	2.7	953
Four Mile Cyn. Ck.	126	1.9	239
Bull Canyon. Ck.	160	0.6	96
Fly Valley Ck.	190	1.1	209
Corral Ck.	95	2.2	209
Coyote Ck.	884.5	3.0	2,654
Total Adult Paiute Cutthroat			4,151

If the mean value for stations with many sample years is used, the total number of adult Paiute cutthroat trout is 4,726.

Clearly, if correct values for all the sections were used, there are four times as many adult Paiute cutthroat trout in the Silver King Creek drainage as reported in the EIS/EIR.

Errors and Accidents in Rotenone Projects

We have previously documented many accidents that occurred in past rotenone applications (e.g., Exhibit A) Most problems were reported by Regional Water Quality Control Boards doing independent monitoring. Some were found in CDFG reports following rotenone projects. They illustrate the difficulty the Agencies have in executing aquatic poisoning projects without major incidents and unforeseen accidents.

Hazards and Hazardous Materials

The EIS/EIR declares there is no need to consider Hazards and Hazardous Materials because "...The proposed Action and alternatives would not transport...or dispose of hazardous materials (p. 4-3)." How, then, can the Agencies get to Silver King Creek with 300-600 pounds of potassium permanganate and 20 (or 50, p. 3-9) gallons of rotenone fomulation? The project would involve hazardous materials and the EIS must deal with that fact. It must also analyze the poor record the Agencies have for conducting these poisoning projects responsibly and without accidents.

Interactions of Rotenone With Other Pesticides

There is strong evidence that residues of common herbicides, insecticides and piperonyl butoxide (PBO) may remain in aquatic sediments (Woudneh and Oros 2006) or in the water, even in remote national parks (LeNoir et al., 1999, Angermann et al., 2002) and that they affect aquatic organisms (Relyea 2005).

With many toxins, such as rotenone, antimycin and other pesticides, the effect on the electron transport system in mitochondria is mediated by an organism's natural defenses. But when certain compounds are also present in the environment, toxicity is increased because the natural defense system (cytochrome P450) is reduced (Li et al., 2007). This result is well established for the role of PBO, a synergist in formulations of rotenone and other insecticides. However, it is also known that other pesticides themselves may function much like PBO (in blocking cytochrome P450) and, hence, increase substantially the toxicity of insecticides. The EPA is aware of these relationships, and in their rotenone risk assessment EPA cited the work by Bills et al., (1981), for example, that showed polychlorinated biphenyls (PCBs) multiplied the toxicity of rotenone to fish. There is other work that has established similar relationships among a range of pesticides and herbicides (e.g., Bielza, et al., 2007).

It is likely that low level residues of pesticides are present now in many aquatic habitats and that PBO is present in sediments of Silver King Creek from earlier projects. We are unaware of any fish poisoning project that has analyzed water or sediments for low level pesticide residue prior to applying piscicides. The effects of rotenone formulations in these waters are underestimated because of the possible presence of other pesticides already in the water.

Rotenone and Parkinson's Disease

Prentiss Inc., Foreign Domestic Chemicals, and Tifia International LLC, manufacturers of rotenone in the U.S., have petitioned the EPA to remove rotenone from the list of pesticides for terrestrial use, but not (yet) for aquatic use (EPA wesite). We suspect, but do not know for sure, that this petition is because of the growing evidence of the connection between rotenone and Parkinson's disease.

The discussion in the EIS/EIR (p.5.3-9) of potential links between rotenone and Parkinson's disease (PD) is as incomplete as that given in the American Fisheries Society's Task Force on Fishery Chemicals (2000). Since the original article by Betarbet et al., 2000, many studies have been published in peer reviewed literature on this association. At latest count, there are 352 studies linking rotenone and PD in the Web of Science. In a recent review on the more general link between PD and many pesticides, including rotenone (Hatcher et al., 2008), the authors noted that "...rotenone is very hydrophobic and, thus, easily can cross biological membranes without the need for a transporter." They concluded "there is evidence of a role for rotenone in PD pathogenesis" although it is "unlikely a major contributor because of its limited commercial use, short half-life in the environment and low bioavailability." Similarly, Brown et al., (2006) concluded that sufficient data suggest rotenone affects development of PD. They, too, caution that although the weight of evidence is sufficient to conclude that a generic association between pesticide exposure and PD exists, more data are needed to prove conclusively cause-effect.

Furthermore, rotenone testing for PD associations generally have not included other cube resins, especially deguelin and tephrosin (Fang and Casida 1999, Cabizza, et al., 2004), that are major components equal to or greater in concentration than rotenone in the active ingredients of the proposed piscicide formulations. For example, in Nusyn-Noxfish the active ingredients are 2.5% rotenone, 2.5% piperonyl butoxide, and 5% other cube resins. These cube resins have been likewise shown to interfere with mitrochondial function in the same way as rotenone (Caboni et al., 2004).

Silver King Creek is in a remote area. The threat of exposure to rotenone and the threat of Parkinson's Disease would be primarily to the people applying the poisons and working along the stream during the project.

Rotenone Concentrations

The EIS/EIR states that the proposed project would use lower rotenone concentrations than have been used in the past (e.g., p. 5.3-11). We find no basis for this statement. The proposed chemical formulations would all result in a target concentration of 25 $\mu g/L$ of rotenone (Table 5.3-1). According to Trumbo et al. (2000a) this target concentration is exactly the same as that used from 1991 to 1993.

Alternative 3, Combined Physical Removal of fish

Alternative 3 is dismissed by the Agencies as being too difficult and taking too long. We disagree. Mechanical removal of fish, using seines, blocking nets, and electrofishing equipment is possible and can be done in ways that would not greatly disturb the aquatic environment or species.

Thompson and Rahel (1996) found that with three-pass removal electofishing they were able to remove a high proportion of fish in 1 year. The lowest efficiency was for small (age-0) brook trout. However, because the remaining fish the next year were immatures, there was no reproduction and thus, "recruitment was virtually nonexistent following 1-2 years of population control." Therefore, once the large fish are taken, the problem gets easier.

The USFS is currently removing non-native fish in the Upper Truckee River as part of a Lahontan CT Trout restoration project, and they are doing it with a combination of electrofishing and gill netting (See attached Exhibit E). They tried poisoning with rotenone first to remove brook trout in Meiss Meadow and failed. They then switched to electrofishing and were successful as of 2007. They are continuing mechanical removal in the Upper Truckee River. The attached map in Exhibit E illustrates a complicated habitat.

In Sequoia-Kings Canyon National Parks, biologists recently have been successful in removing all fish from small lakes and feeder streams by entirely physical means (nets and electrofishing) (D. Boiano, NPS fishery biologist, pers. comm. 2005). Fish have been successfully removed from lakes using gill nets in other places (e.g., Knapp and Matthews 1998; Pope et al., 2009).

In the Silver King Creek system electrofishers could begin at the upstream areas and move downstream so that downstream drift of fish would not be a problem. Block nets could be positioned to limit fish movement between upstream and downstream sections. Regular tending of nets to remove debris or maintain position should be possible, especially with volunteers. The Agencies can make little use of volunteers in the poisoning option, given the requirements of training, licensing, risk, and Personal Protective Equipment. But physical removal would be amenable to volunteer labor needed for the many tasks and could effectively reduce total project costs as well as enhance project efficiency (e.g., tending block nets, hauling supplies, refreshing workers, etc.).

An excessively high voltage is not necessary to collect fish, but fish would have to be killed and buried after they are collected. Moving non-native hybrid fish to other areas in the Wilderness Area and in the same East

Carson River drainage, as the Agencies have been doing, is unsound management that leads to more problems later and should be ceased immediately in all Wilderness Areas.

Conclusion

In conclusion, the single species management approach proposed in the preferred alternative is out-of-date. It should be rejected. Ecologists have known for decades that species are interwoven and interdependent. Applying non-specific poisons to whole communities for the goal of expanding the range of a single population of fish is unacceptable in modern ecology. The preferred alternative would cause long-term changes of at least 6 years to the structure and function of the biological community. Poisoning may eliminate some non-target species forever, as the Agencies admit in this EIS/EIR. The Clean Water Act requires that existing uses be protected in waters of exceptional quality. The Agencies have refused, again, to conduct a species level inventory of aquatic invertebrate species. An alternative management strategy exists and should be used if the agencies want to try to eliminate the non-native fish they have stocked in the stream system. But before even that alternative is contemplated, a critical question is whether or not an impermeable barrier to upstream fish movement exists. Further, scientists are unable at this time, to genetically differentiate between Lahontan cutthroat trout and Paiute cutthroat trout, and the Agencies cannot visually distinguish "pure" Paiute cutthroat trout from hybrids, thereby making management strategies unrealistic.

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EX. A

Comments submitted by e-mail to: opp–docket@epa.gov. PLEASE CONFIRM RECEIPT. Document is 22 pages including 8 figures. Hard copy to follow by mail to:

Public Information and Records Integrity Branch (PIRIB) (7502C),
Office of Pesticide Programs (OPP),
Environmental Protection Agency,
1200 Pennsylvania Ave., NW, Washington, DC 20460-0001.
Docket ID No. OPP-EPA-HQ-2005-0494.

April 10, 2006.

To:
Environmental Protection Agency
Rotenone Risk Assessments
Attention Docket ID No. OPP-EPA-HQ-2005-0494

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We are aquatic ecologists who have reviewed over the past several years many of the rotenone poisoning projects conducted or proposed by the California Department of Fish and Game (CDFG) on streams and lakes on public land in California and by other state fish and game agencies, by the US Fish and Wildlife Service (FWS), and as permitted by the USDA Forest Service (US Forest Service) throughout the West. We are submitting these comments as private citizens in the public interest. We are commenting specifically on the effects of rotenone when used as a "piscicide" in the nation's streams, rivers, and lakes.

Rotenone versus synergized rotenone formulations:

The Environmental Protection Agency should recognize and distinguish among the many formulations of "rotenone." Pure rotenone is rarely used in fish poisoning operations. For example, the formulation of choice by CDFG in California over the past many years has been Nusyn-Noxfish, which contains other toxic cube resins, such as deguelin, and piperonyl butoxide in percentages equal to rotenone. Deguelin, tephrosin and other rotenoids have been shown in published reports to have the same properties as rotenone as an insecticide. Piperonyl butoxide is highly acutely toxic to aquatic macroinvertebrates (EPA, National Pesticide Telecommunications Network). These formulations also contain many other inert ingredients that are not desirable for release into natural waters.

Collateral damage to non-target species and aquatic communities from the application of rotenone formulations:

Rotenone formulations can not be referred to merely as "piscicides" (as this EPA announcement has) thereby implying that they kill only fish. In fact, rotenone formulations act as a poison on many non-target organisms and have major long-term impacts on aquatic invertebrates and on amphibians. Rotenone inhibits the ability of fish and other aquatic animals that obtain oxygen from water, to use oxygen.

The CDFG and the US Forest Service have recently been requesting rotenone projects of three years duration, with up to two applications per year, because they have had so little success in eliminating unwanted fish with one-year applications (e.g., US Forest Service Decision Notice 2004). And often these poisoning regimens have been repeated on approximately 10-year cycles in the same stream basins or lakes. The great majority of aquatic invertebrates have one-year life cycles. A three-year project eliminates many invertebrates from the stream and riparian area for as long as four years and longer. Many terrestrial animals are dependent on the food source of emerging stream insects, amphibians, and fish and are put at risk from these projects because a major part of their food supply is eliminated for several years. This cascading effect in food webs is a major ecological disturbance.

The impacts of rotenone on aquatic invertebrates are well known, have been studied for many years and continue to be studied (e.g. Almquist 1959, Binns 1967, Meadows 1973, Helfrich 1978, Engstrom-Heg et al. 1978, Chandler 1982, Dudgeon 1990, Mangum and Madrigal 1999, Cerreto et al. 2003). The impacts are variable depending on the sensitivity of each species to rotenone. Some species may be eliminated or greatly reduced while more resistant species are increased after rotenone poisoning. Cosmopolitan or "weedy" colonizer species, relatively insensitive to rotenone, tend to replace more sensitive species and the overall species diversity decreases.

Most of the aquatic invertebrate studies have been short-term. Most have only identified larval aquatic insect forms and, therefore, have not determined the number of species affected or eliminated by rotenone. If a higher taxon than a single species is affected, one can assume that a higher number of species is being affected. For example, when a study reports that a genus, family, or order has disappeared or shown major stream drift, one must assume the taxon represents more than one, and perhaps many, species.

In a short-term study on a Pennsylvania stream, Helfrich (1978) found that all 4 major orders of macroinvertebrates in the study stream exhibited substantial decreases in numerical abundance 11 days after rotenone treatment. Populations of Plecoptera and Diptera were "nearly exterminated." Trichoptera and Ephemeroptera were reduced to 50% of the pretreatment levels.

A 5-year study on a river in Utah (Mangum and Madrigal 1999) found that "up to 100% of Ephemeroptera, Plecoptera, and Trichoptera [mayflies, stoneflies and caddisflies] were missing after the second rotenone application. Forty-six percent of the taxa recovered within one year, but 21% of the taxa were still missing after five years. At least 19 species were still missing five years after the rotenone treatments. (We say "at least" because some taxa were identified only to genus and may have included more than one species). It should be noted that the rotenone formulation that was used in the Mangum and Madrigal study was Noxfish, which does not contain the synergist piperonyl butoxide found in

Nusyn-Noxfish. We would expect even more toxic effects to macroinvertebrates from Nusyn-Noxfish.

The California Lahontan Regional Water Quality Control Board required that the CDFG conduct monitoring on aquatic macroinvertebrates before and after the application of Nusyn-Noxfish to several streams in the Lahontan region. We have obtained CDFG reports and data from two of those studies, one on Silver King Creek, 1990 through 1996 (Trumbo et al. 2000 a), and the other on Silver Creek, 1994 through 1998 (Trumbo et al. 2000 b), both in the Carson–Iceberg Wilderness Area, Humboldt-Toiyabe National Forest, CA. We also obtained most of the original data reports that were prepared by the USDA Forest Service, National Aquatic Ecosystem Monitoring Center Laboratory, Provo, Utah for these two CDFG reports.

F.A. Mangum of the National Aquatic Ecosystem Monitoring Center Laboratory, prepared the reports from data collected before and after the 1991-1993 poisoning of Silver King Creek above Llewellyn Falls. We found the following quotes in the data report submitted to the California Department of Fish and Game in 1997 from the USDA Forest Service, National Aquatic Ecosystem Monitoring Center Laboratory, Provo, Utah. (Mangum, F.A. 9 Jan. 1997. Aquatic Ecosystem Inventory - Macroinvertebrate Analysis Silver King Creek, 1996. USDA Forest Service, National Aquatic Ecosystem Monitoring Center Laboratory, Provo, Utah):

Station 1, Control Section, Four Mile Creek

"Many of the species missing in Silver King Creek following rotenone treatments were still found in Four Mile Creek." (p. 8)

Station 2, Silver King Creek

"16 taxa (33%) found in the pre-rotenone community were still missing;" (p. 14)

Station 3, Silver King Creek

"There were still 11 taxa or 28% of the pre-rotenone community still missing at this station;" (p. 15)

Station 6, Silver King Creek

"...there were still 17 taxa or 38% of the pre-rotenone community missing;" (p. 15)

Station 7, Silver King Creek

"...but 13 taxa (30%) were still missing from the pre-rotenone community at this station; see Table 4. Most of the missing taxa have been observed to be sensitive to rotenone." (p. 16)

Station 8, Silver King Creek

"There were still 14 taxa (30%) missing at this station compared to pre-rotenone samples;" (p. 17).

Our analysis of the same data indicates an even higher number of macroinvertebrate taxa missing three years after the last poisoning on Silver King Creek. The average percent missing taxa from the five treatment stations was 41.9%; the highest percent taxa missing from a single station was 46.7%.

Some of our analyses of these data are summarized in Figures 1 through 8. We found that macroinvertebrate diversity in Silver King Creek was significantly reduced two and three years (considered long-term in the Lahontan Basin Plan) following poisoning with Nusyn-Noxfish (Fig. 1) and that peltoperlid stoneflies were greatly reduced in the long-term (Figs. 2 and 3). Percentage of taxa that were still the same at the poisoned stations after they were poisoned compared to before was significantly lower than at the control station (Fig. 4). In Silver Creek (a different stream from Silver King Creek) the mean number of taxa were significantly reduced two years after the last poisoning (Figs. 5 and 6), stonefly abundance was greatly reduced (Fig. 7), and peltoperlid stoneflies had nearly disappeared two years after the last rotenone poisoning (Fig 8). The peltoperlid stoneflies had been the most abundant stonefly group prior to poisoning.

In 2003, CDFG provided the Lahontan Regional Water Quality Control Board (LRWQCB) staff misleading information when they claimed that "No evidence of long-term impacts were found in either study" (Interagency Study Proposal, LRWQCB files, June 15, 2003, Evaluation of Rotenone use in Silver King Basin on Aquatic Macroinvertebrates, 2003-2007). Our analysis of the data available in the reports showed otherwise.

Our analyses of these data will continue as agencies release the data to us. However, it has been extremely difficult to get all the data and the US Forest Service and CDFG failed to release a complete set of data from these two streams even to the Lahontan RWQCB after the Board formally requested it.

We know that an average of 41.9% of the broad taxa of macroinvertebrates were still missing from the Silver King Creek drainage as long as three years following the last rotenone treatment. We do not know how many species these taxa represent. To our knowledge, neither the US Forest Service, CDFG, nor the USFWS have ever made an inventory of macroinvertebrate species prior to a stream or lake poisoning project in California. There is no way to know whether or not other rare and/or endemic macroinvertebrate species are in a project area prior to poisoning or whether or not any of the macroinvertebrate species ranked as endangered, restricted range, or rare in the California Natural Diversity Database are present. We think this lack of knowledge of aquatic species present prior to rotenone poisoning extends throughout the US.

Many of the stream poisoning projects now being carried out or proposed in the western US are in the most pristine and unspoiled streams and rivers of the country in designated Wilderness Areas and national parks. Many are in isolated headwater areas that have a high probability of containing other rare and endemic aquatic species, for the same reason that they have rare subspecies of fish. Our research has revealed rare and/or endemic species of invertebrates in many springs and headwater reaches in the Sierra (e.g., Erman and Erman 1990, 1995). We also have found that aquatic invertebrate species persist in undisturbed streams over many years. Other researchers also have found persistence of invertebrate taxa in undisturbed streams over many years (e.g., Robinson et al. 2000). These are the sites that should be most protected.

Studies of insect dispersal in Europe have found that biological recovery of aquatic insect communities following insecticide poison events or severe organic pollution may take decades (Sode and Wiberg-Larsen 1993).

The mountain yellow-legged frog and the Yosemite toad are both candidates for listing as endangered species and both are or were found in stream basins in the Sierra Nevada that are proposed for fish eradication or where fish eradication has been attempted for many decades. There is no time during the year that tadpoles of the mountain yellow-legged frog would not be in a stream in higher elevations because the mountain yellow-legged frog spends up to four years as a tadpole. Adult frogs are highly aquatic compared to other amphibian species (Dr. Kathleen Matthews, USDA Pacific Southwest Experiment Station 2003, High Sierra Ecosystems, Science Perspectives, USDA Pacific Southwest Experiment Station).

<u>Inability of fish and game departments to properly manage rotenone applications in the field:</u>

Use of rotenone as a fish poison requires that rotenone must be neutralized chemically in order to control its toxic effect downstream from treatment areas. This chemical neutralization is commonly attempted with potassium permanganate. Failure by the CDFG to achieve complete neutralization and to cause fish kills from the potassium permanganate itself is documented in California Regional Water Quality Control Board (RWQCB) files.

We have read reports from the Lahontan RWQCB files and from CDFG files. During rotenone poisoning of Silver King Creek, Mono County, 1992, approximately 1000 fish were killed downstream of the project area from the application of potassium permanganate (Lahontan RWQCB files). The following year, 1993, during a repeat poisoning of the same area, detoxification of the rotenone was chemically incomplete (Flint et al. 1998). The record shows that CDFG has difficulty managing the performance of potassium permanganate and detoxifying the rotenone.

In the Lahontan Region alone, 6 of 11 rotenone projects since 1988 have violated water quality standards. Rotenone, rotenolone, or naphthalene have been detected downstream or have persisted longer than limits established in Basin Plans (Lahontan RWQCB files).

During application of rotenone in Silver Creek, Mono County, in 1994, independent testing by the Regional Water Quality Control Board found carcinogenic compounds in water. In contrast, testing by CDFG at the same sites found no detectable carcinogenic compounds (Lahontan RWQCB files).

Rotenone was detected in sediment during a CDFG project in Silver Creek, Sept. 20, 1995. CDFG was well over their target application rate of rotenone, with data apparently missing at a critical period (Lahontan RWQCB files).

Rotenone and its breakdown products have persisted in water for long periods after CDFG poisoning projects (Lahontan RWQCB files).

Higher amounts of rotenone have been used than are recommended because of accidents (e.g., Flint et al. 1998). In Silver King Creek non-native fish in live cars (used to monitor effectiveness of the poison) escaped into the stream section being poisoned, not once but twice (Flint et al. 1998). As a result, "the creek was heavily doused with rotenone from backpack sprayers so that total concentrations peaked at 40 $\mu g/l$ at detox, about twice (sic) expected." Not all the escaped fish were found (Flint et al. 1998). Thus, even as CDFG was attempting to get rid of fish, they were accidentally introducing them.

Rotenone can not solve the problem of unwanted fish species

Until the responsible agencies recognize and acknowledge the underlying reasons for many of the unwanted species in the nation's waters and riparian zones, they will be unable to solve the problems with pesticides.

Non-native fish species have been and continue to be stocked by state fish and game agencies and by the US Fish and Wildlife Service. These species were/are stocked without environmental review and constitute a form of biological pollution. Perhaps the greatest threat of these stocking programs is the lesson they teach the public: it is a good idea to move fish around. For this reason and because of the continued official agency fish stocking, few fish eradication projects are successful in removing unwanted fish species over the long term (see for example, the decades-long records of poisoning streams and springs in the Golden Trout Wilderness and the Carson–Iceberg Wilderness, CA).

Rotenone formulations usually can not kill all the unwanted fish. An attempted fish eradication project in a reservoir, Lake Davis, CA, in the mid 1990s failed to eradicate the northern pike, poisoned a water supply for the town of Portola, and cost the state $15 million, some paid in reparations to the local community (Braxton-Little, Sacramento Bee, March 1, 2005). Components of the rotenone formulation, including piperonyl butoxide, persisted in the reservoir long after the poisoning was conducted. Portola has not used water from the reservoir since that time. The pike have been thriving in the intervening years, probably partly due to elimination of predators and competitors. The reservoir had been stocked with many non-native fish, but the northern pike was an illegal stocking, that is, a species not stocked by the CDFG. It is not easy for members of the public to understand why they can not stock the fish they want, if fish and game agencies can do it.

Freshwater habitats in the US are undergoing degradation and biological impoverishment from many sources (Erman 1996). It makes little sense to add poisons to streams and lakes in misguided attempts to save threatened and endangered fish without comprehensive understanding of why these fish species are endangered and with no concern for endangering other non-target species. It was never the intent of the Endangered Species Act to conduct recovery projects to increase single species that would put other species at risk of extinction.

Inadequate EPA review of connection between rotenone and Parkinson's Disease

The EPA rotenone risk assessment document has provided inadequate review and analysis of the connection between rotenone and Parkinson's Disease. In the various sections where the topic comes up, the EPA has repeated the statement "although several studies have linked sub-chronic rotenone exposure to Parkinson's disease-like symptoms in laboratory rats, the exposure methods used to obtain these results are not typically encountered through the current registered uses of rotenone." A critical analysis of the literature on this subject is restricted in the EPA document to the original study by Betarbet et al. (2000) and a paper on zebrafish by Bretaud et al. (2004). The Betarbet et al. study methods are critiqued and the findings judged of "uncertain relevancy" (p. 55 and elsewhere) as if this initial paper which first showed the connection between rotenone and Parkinson's disease is the sum total of current knowledge and technique. Such a review and analysis is insufficient for an EPA document of this importance.

The Web of Science presently lists 210 scientific papers connecting rotenone and Parkinson's disease. Many of these are extremely relevant to the EPA assessment, for example, Vanacore et al., 2002, have conducted a meta-analysis of all case control studies to the date of their work and are following the fate of a cohort of licensed pesticide users. More recently, Brown, T.P. et al., 2006, reviewed the extensive and growing literature on this subject and found "...a relatively consistent relationship between pesticide exposure and PD" and "...data suggest that paraquat and rotenone may have neurotoxic actions that potentially play a role in the development of PD..."

Inadequate EPA review of components of rotenone formulations

The EPA rotenone risk assessment document is incomplete in its treatment of ingredients associated with formulated end-products of rotenone. It has concluded that cube root resins do not contribute substantially to the toxicity of rotenone because technical grade rotenone is twice (at least) as toxic as the formulated end-product of rotenone. This conclusion is apparently based on the data reported in Table 3.17 for three formulations, Prentox Grass Carp Management Bait, Chem Sect Chem Fish Regular, and Chem Sect Cube Root Powder Toxicant.

However, the range of fomulations presented does not cover the range of actual formulations, associated products or potential toxicity. For example, work by Cabizza et al., 2004, found residues on olives of deguelin, tephrosin, and beta-rotenolone were very similar to rotenone and some data indicated similar acute toxicity values for deguelin and rotenone. The EPA and producers of rotenone products (e.g., Chem Sect Chem fish Regular, Table 3.17, and Nusyn-Noxfish and CFT Legumine) combine all such active compounds as "cube root resins" although their relative amounts and toxicities in end-product formulations are not equivalent. The limited data presented in Table 3.17 of the document support caution in making conclusions about toxicity of other cube resins. For example, Chem Sect Chem Fish Regular, 5% rotenone and 5% other cube resins, was 8 times more toxic to male rats than the other two products that contained no other cube resins. There are no data to reveal whether the other cube resins in Chem Sect Chem Fish Regular were rotenolone, tephrosin, deguelin or a mixture, or which was predominant.

Detailed work on extract from the source plant (*Lonchocarpus*) has found as many as 25 other minor rotenoids in cube resin (Fang andCasida 1999). Thus, other "cube root resins" is too broad a term for useful toxicity characterization and a more complete discussion and review is required than is in the EPA document.

Recommendations

We recommend 1) that the use of rotenone as an aquatic poison be halted in most cases in the US, 2) that its use should always require an NPDES permit [See earlier comments we submitted to the EPA, Attention Docket ID No. OW–2003–0063, April 1, 2005], and 3) that where it is permitted, application should be monitored and overseen by an independent, unbiased agency. The agencies promoting the use of rotenone in stream and lake poisoning can not be relied upon to also monitor and accurately report the effects of its use. We think that independent aquatic scientists, including macroinvertebrate and amphibian specialists, must be involved in the analysis of the impacts of rotenone on aquatic communities and species of non-target organisms.

Summary

To summarize, aquatic poisons rarely solve the problems for which they are used because the same fish and game agencies that promote them continue to stock non-native fish. Members of the public learn from the example of the agencies and also move fish around. And fish poisoning often does not kill all the target fish.

The record is clear that the state and federal agencies using rotenone in California streams and lakes are incapable of applying the products without major problems.

We think the impacts of rotenone use in the streams and lakes of the US over the past 60 or 70 years has significantly reduced the diversity and changed the communities of aquatic macroinvertebrates and has probably eliminated some, perhaps many, non-target species. It has likely also had a major effect on some amphibians and has had a secondary food web effect on terrestrial animals that depend on fish, amphibians, and emerging aquatic insects for food. The effects of "piscicides" in general on non-target species have been understudied, poorly analyzed, and denied or ignored by some of the state and federal agencies involved in stream and lake poisoning.

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Explanation of figures:

Figure 1. Silver King Creek Macroinvertebrate Diversity Long-term Response to Nusyn-Noxfish (a rotenone poison).

Plot of the Margalev diversity index. Data is from Trumbo et al. (2000a) It compares the mean diversity index (± 1 standard error) for the control site (Station 1 in Trumbo et al. 2000a) and the sites eventually poisoned (Stations 2, 3, 6, 7, 8). The bars labeled "Before" are mean values for the two years before poisoning (1990 and 1991 before poison). The bars labeled "Long-term" are mean values for the two years, 1995 and 1996, following the last poisoning in 1993.

Figure 2. Silver King Peltoperlid Stoneflies.

Mean number of individuals (± 1 standard error) of the stonefly family Peltoperlidae, a taxon difficult to mistakenly identify. Data are from Trumbo et al. (2000a). Data in the Trumbo et al. (2000a) report are in tables of Plecoptera by taxon. Values for all taxa in the family Peltoperlidae (i.e., *Yoroperla brevis*, *Yoroperla* and Peltoperlidae) were summed for each date and station. "Before" on the x-axis means before poison and includes the samples from 1990 and 1991 (before poisoning). "During" includes the samples from 1991 after poisoning, 1992 before and after, 1993 before and after, and 1994 (one year after final poisoning). "Long-term" includes samples from 1995 and 1996, two and three years following the final poisoning.

Figure 3. Percentage of Peltoperlidae in Silver King Creek (of all Stoneflies).

This plot is of the same data and source as Fig. 2 except the number of individuals of Peltoperlidae from the poisoned stations (Stations 2, 3, 6, 7, 8) are divided by the total number of individuals of all taxa and expressed as a percentage (± 1 standard error). The periods and samples are the same as in Fig. 2.

Figure 4. Percentage of taxa the same as those found before poisoning began, Silver King Creek.

The mean of 5 poison stations includes ± 1 SE. Data were not available for 1992 at the Control station. 1992 and 1993 include samples from before (b) and after (p) poison applied. Long-term results are considered those of 1995 and 1996 according to Lahonton Basin Plan. (Data from Mangum 1991, 1993-1996)

Figure 5. Silver Creek Number of Taxa.

Mean number of taxa (±1 standard error) from a study on Silver Creek (a different stream from Silver King Creek) reported in Trumbo et al. (2000 b. There was no control station in this study. The years are given under the periods used to calculate Before, During and Long-term. All four stations are used to calculate the mean for each bar.

Figure 6. Silver Creek Number of Taxa showing time of poison (Nusyn-Noxfish) application.

This is a plot of the mean number of taxa from Silver Creek based on the same data (Trumbo et al. 2000 b) shown in Fig. 4. The sample periods are given on the x-axis and vertical arrows indicate time of poisoning.

Figure 7. Silver Creek Stonefly abundance

Plot of mean (± 1 standard error) number of individuals (for all taxa in the Stonefly order) for Silver Creek based on data in Trumbo et al. (2000 b). Data are grouped as in Fig. 5. All four stations are used for each bar.

Figure 8. Silver Creek Peltoperlid Stonefly Abundance.

Mean number of individuals (± 1 standard error) of the family Peltoperlidae. The data are from the report by Trumbo et al. (2000 b). Times and stations are as in Fig. 6.

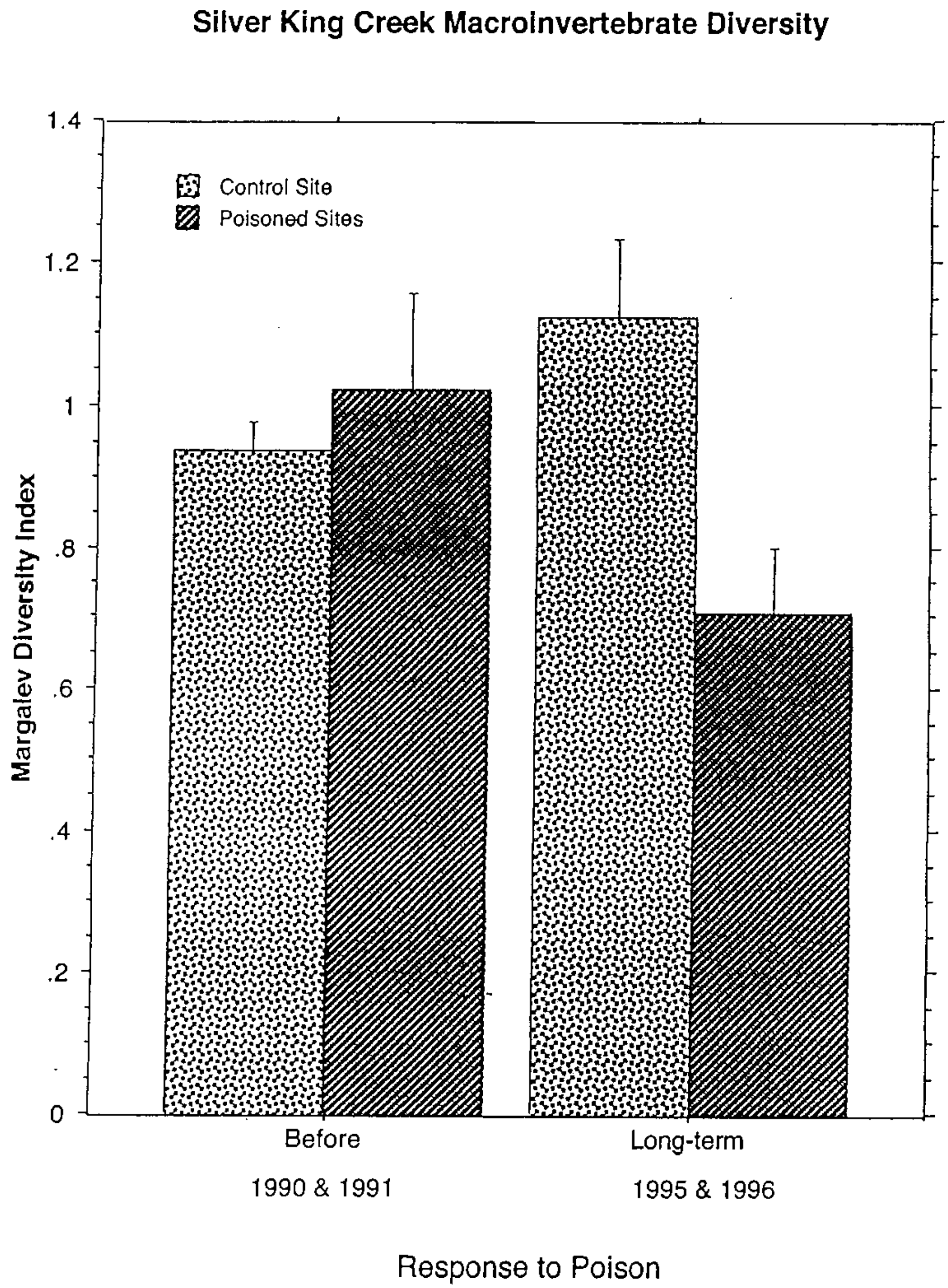

Figure 1. Silver King Creek macroinvertebrate diversity long-term response to Nusyn-Noxfish (a rotenone poison).

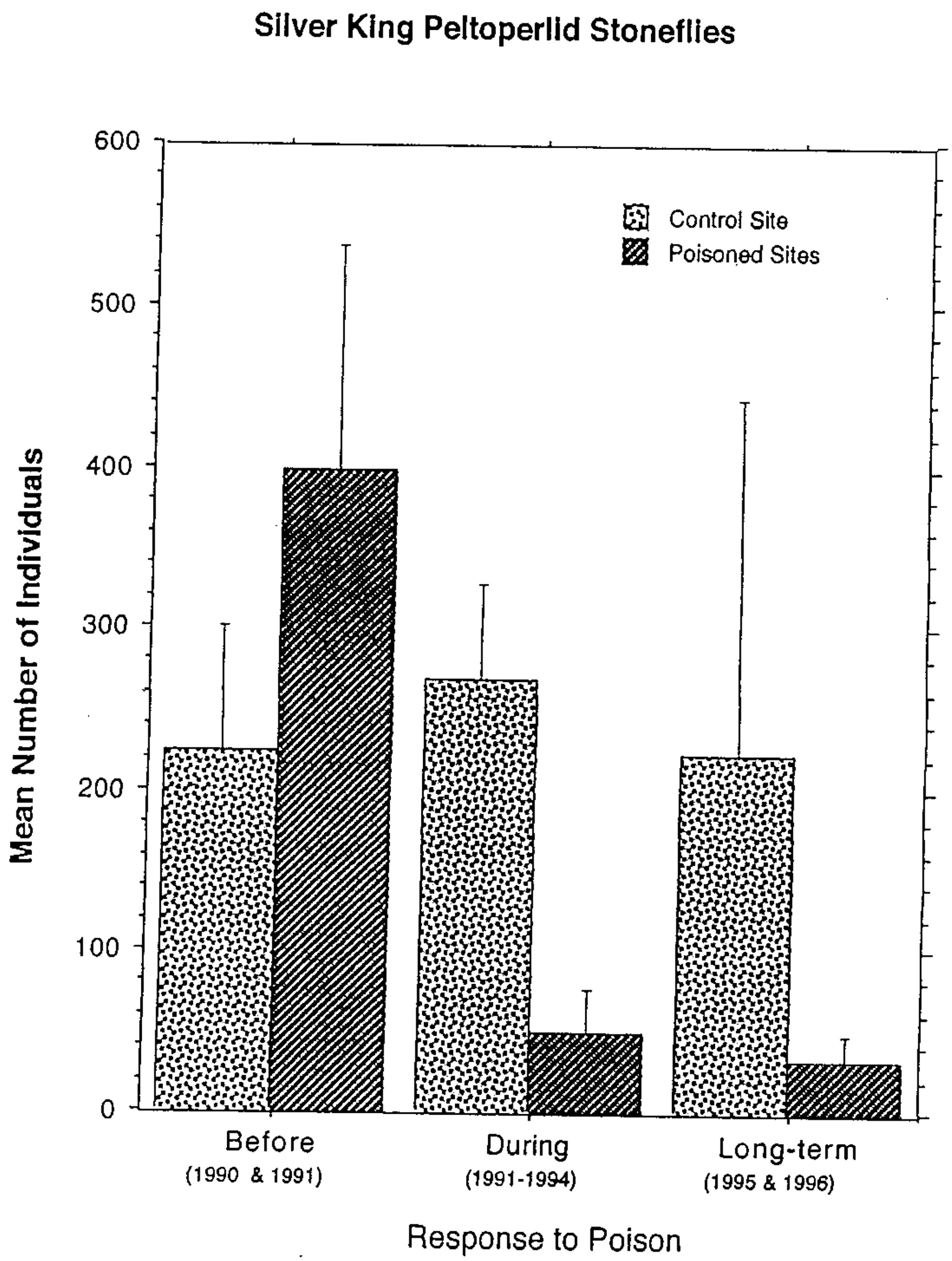

Figure 2. Silver King peltoperlid stoneflies.

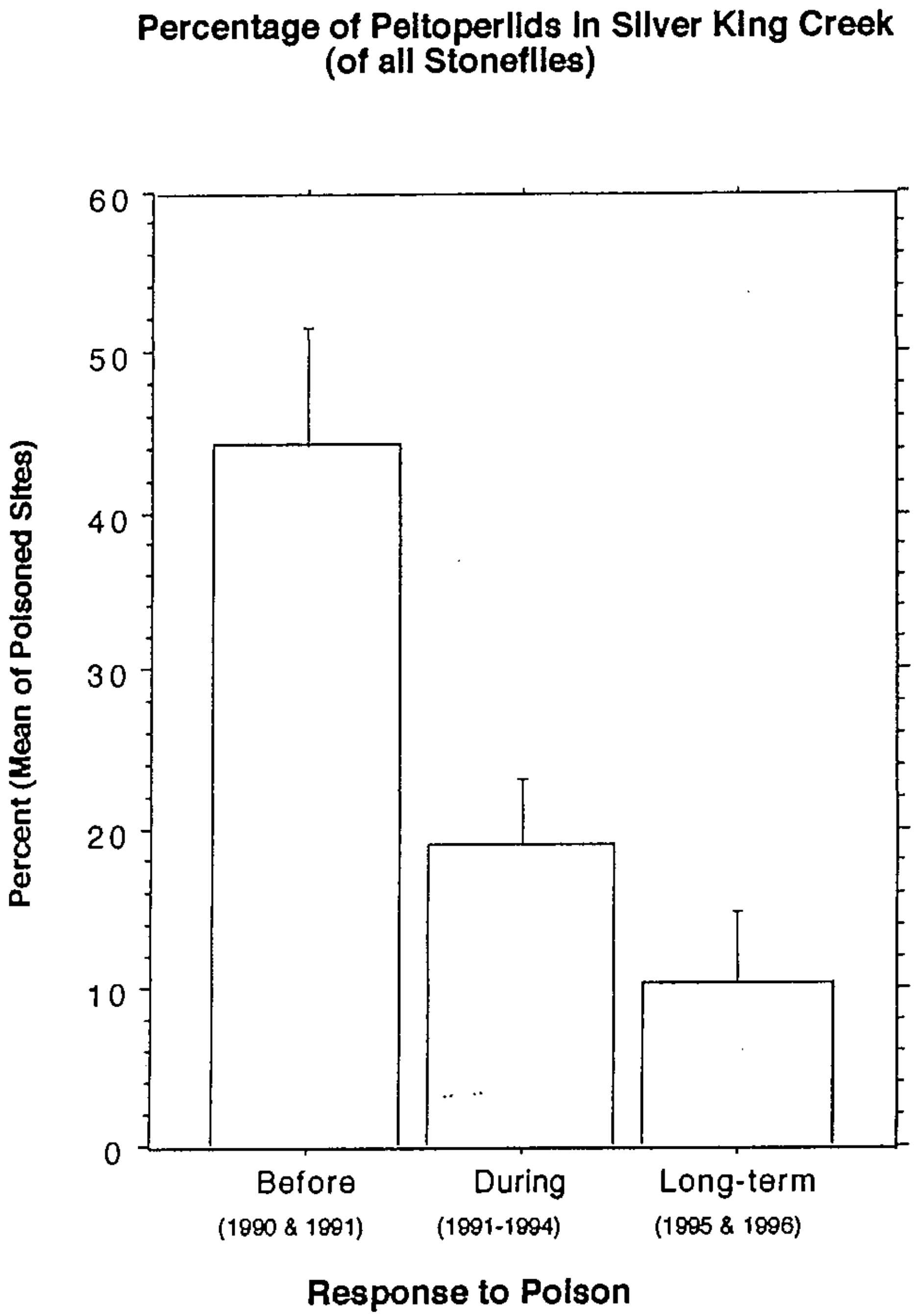

Figure 3. Percentage of peltoperlids in Silver King Creek (of all stoneflies).

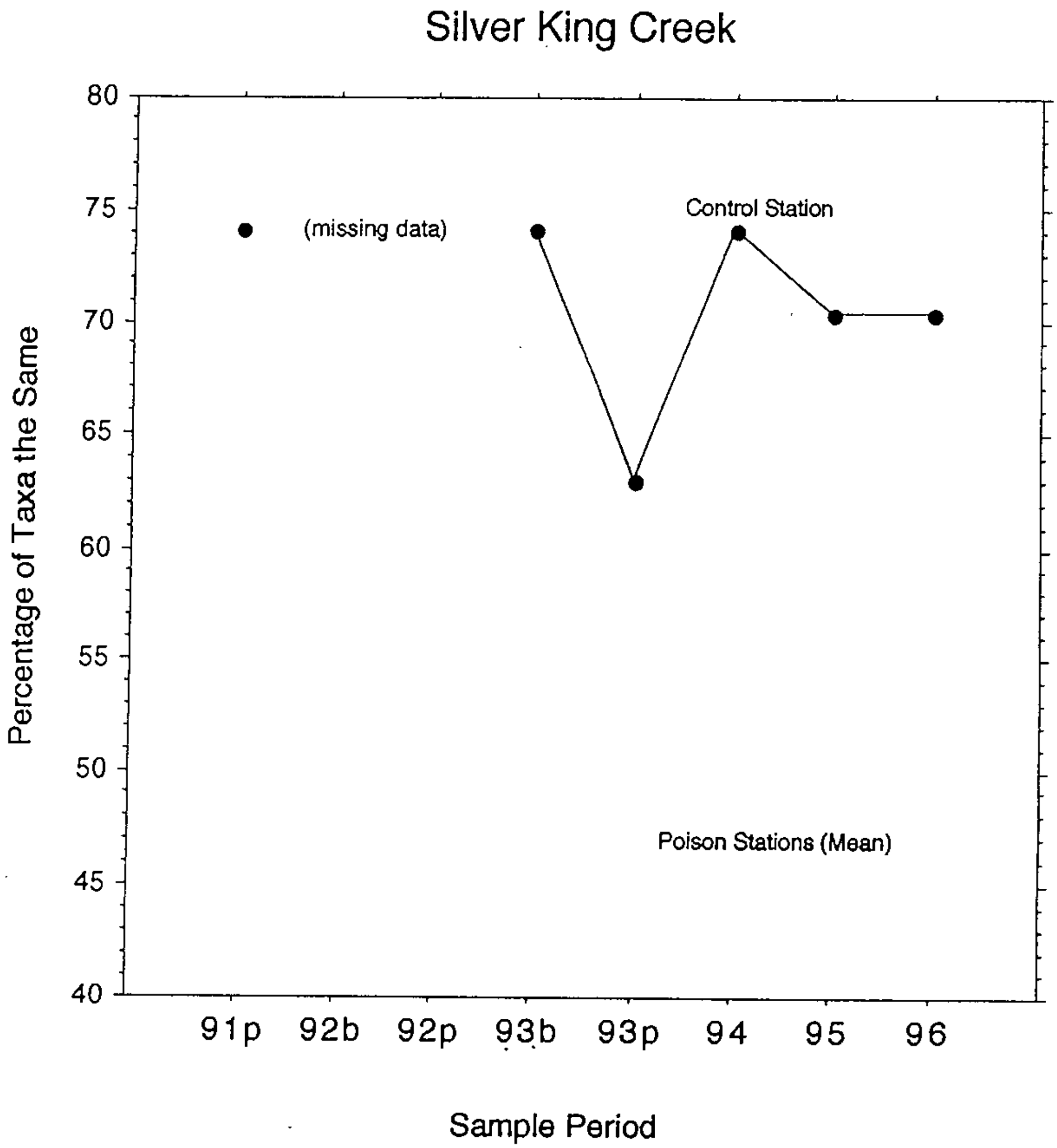

Figure 4. Percentage of taxa the same as those found before poisoning began.

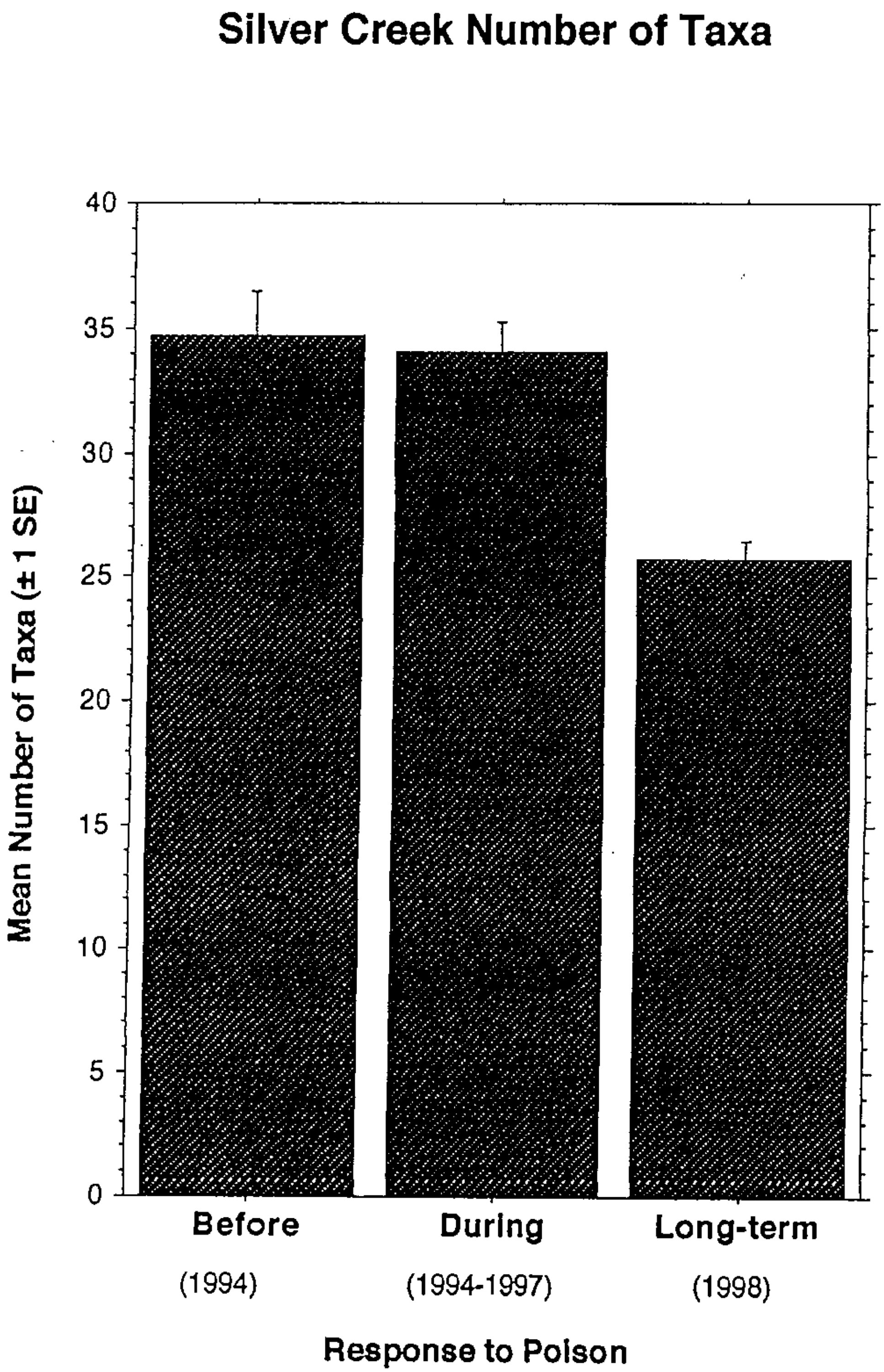

Figure 5. Silver Creek number of taxa.

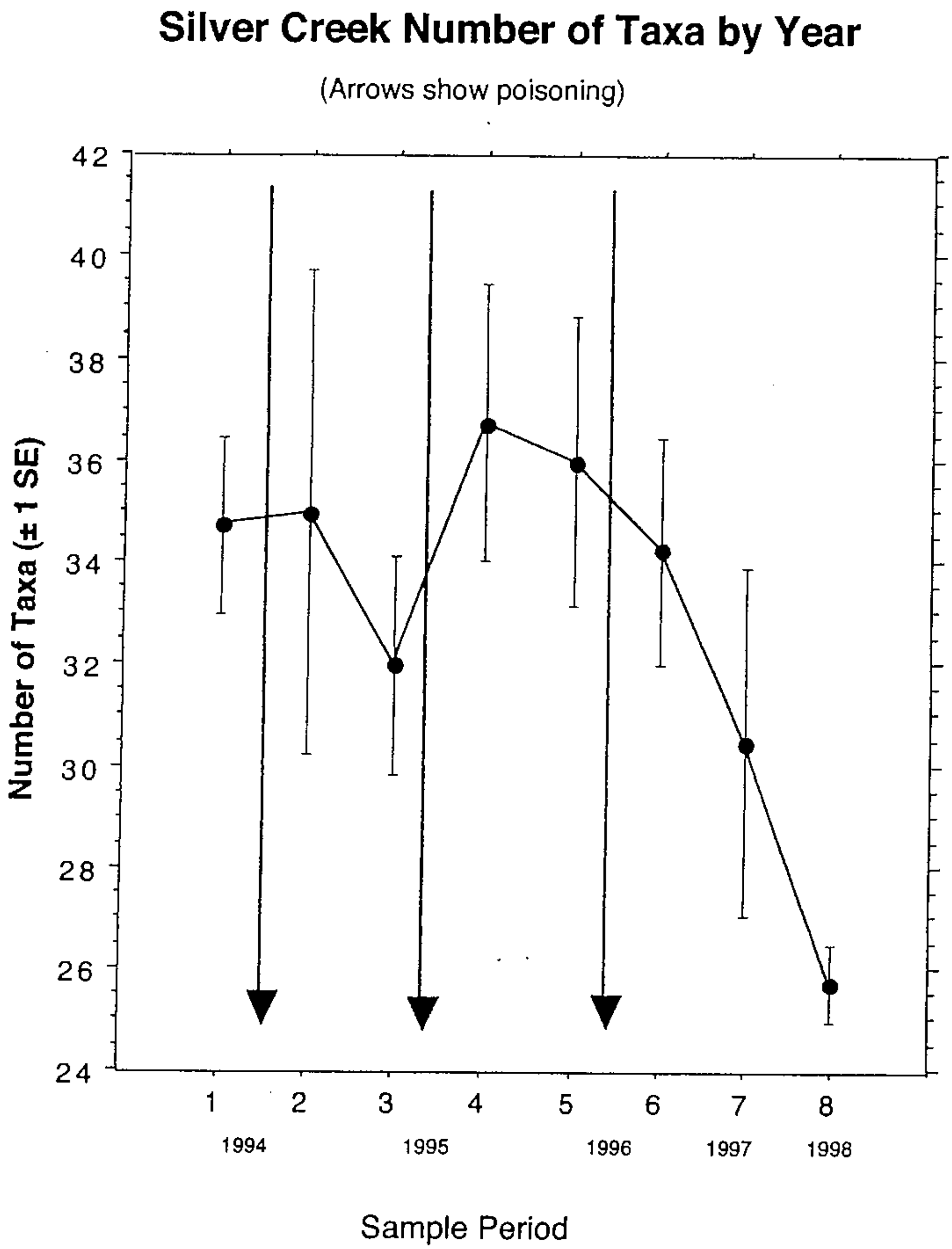

Figure 6. Silver Creek number of taxa showing time of poison (Nusyn-Noxfish) application.

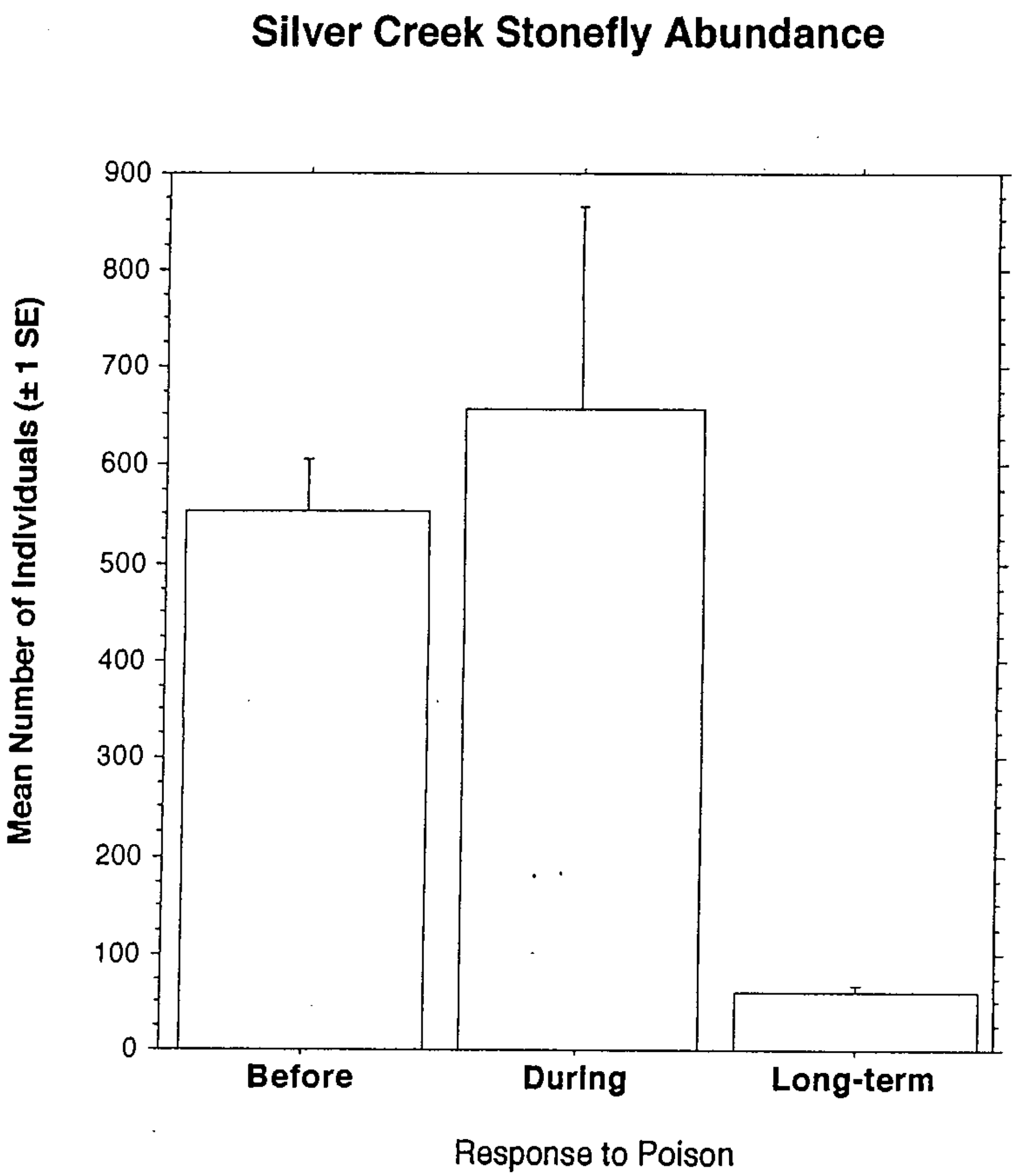

Figure 7. Silver Creek stonefly abundance.

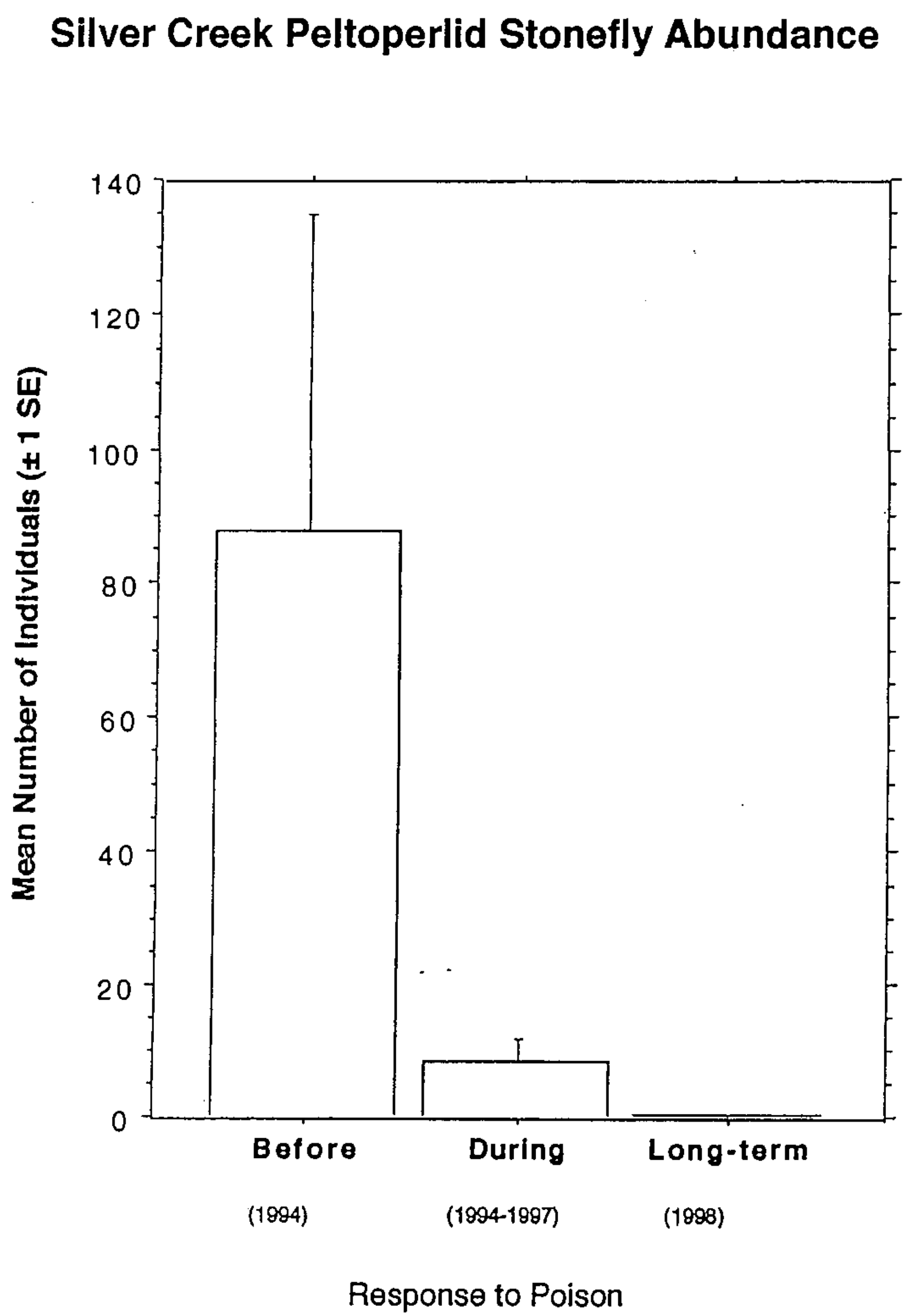

Figure 8. Silver Creek peltoperlid stonefly abundance.

Ex. B

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June 28, 2002

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SUBJECT: COMMENTS ON DRAFT NEGATIVE DECLARATION FOR PAIUTE CUTTHROAT TROUT HABITAT RESTORATION PROJECT, SCH# 2002052136

Dear State Clearinghouse,

I would like to take this opportunity to provide comments on CDFG's proposal to poison several miles of Silver King Creek and its tributary streams and lakes for the purpose of removing exotic trout (SCH# 2002052136).

I have reviewed several reports related to studies of aquatic invertebrate responses to rotenone treatment (Trumbo, Seipmann, Finlayson; on Silver King, and Silver Creek) and other background on potential problems with rotenone and wanted to share some of my thoughts as an aquatic entomologist and research scientist.

Though some data suggest recovery of invertebrate populations after rotenone treatment, these studies need to be examined carefully for design and responses measured. Aquatic invertebrate species are likely to have different colonizing abilities and will reoccupy treated streams on varied schedules. In addition, re-establishment of a stable community structure and trophic relationships are likely to differ from stream to stream, over elevation gradients, and to varying extents along the continuum of ecological conditions that exist from stream headwaters to lowland rivers. Given such variability, rotenone applications should be evaluated on a case by case basis. With regard to the studies cited by the Department of Fish and Game in their rotenone EIR (1985 and 1994) as evidence of low toxicity, I note that these included no controlled replicated field studies, were often conducted in pond habitats (standing water lentic environments, not lotic habitats), and most were over 20 years old. This is, in my opinion, inadequate data to determine whether the recovery of invertebrate communities after rotenone treatment of streams in the Eastern Sierra will take one year, two years, or longer. The studies cited earlier are insufficient to arrive at an informed decision on a specific "timeline" for invertebrate re-establishment. The more recent monitoring studies on Silver King Creek and Silver Creek show mixed results. Although both studies concluded rotenone use did not affect macroinvertebrate abundance, there are other measures of community structure that indicated both short- and long-term affects of rotenone. At Silver King, for example, the data suggest that treatments produced (1) a persistent high level of community dominance (a sign of stress that one taxon comprised 60-75% of all organisms relative to the 20-35% before treatment), (2) transient loss of about 50% or more of EPT taxa (sensitive mayfly-stonefly-caddisfly taxa) during treatment years, followed by 3 years until levels had apparently recovered, and (3) persisting loss of stonefly taxa relative to pre-treatment levels, with an especially notable loss of the abundant Peltoperlid *Yoraperla* through the post-treatment period. Other indicators may have been more revealing, such as calculation of a biotic index (such as Hilsenhoff), and a community similarity index would have been most revealing ~~of~~ in distinguishing whether recovery or only replacement is occurring after treatment (i.e. do the same taxa return, or do "weedy" colonizers replace the original biota?). The single control site selected for contrast in this study does not appear to be a stream of similar size or order to Silver King and so is difficult to interpret. Multiple controls of similar size would provide a more realistic context for contrast. The Silver Creek study showed short-term affects of treatment but none long-term, though this design had no control sites. Both the study designs lacked much taxonomic resolution for some groups such as the Chironomidae, Diptera, and apparently others identified only to family level. This further limits the ability of these studies to detect changes in biological indicators.

Rotenone treatment of streams in this watershed is also troubling to me as an aquatic ecologist attempting to establish biological criteria for water quality in the region. Any impairment (short- or long-term) compromises the potential use of these streams as reference sites, the fundamental unit upon which biological criteria are based.

Other considerations in the use of rotenone:

- Repeated rotenone treatments over consecutive years may pose an additional threat to stream ecosystem recovery because of uncertainty in the capacity of the resident invertebrate fauna to survive such prolonged exposures. The combined effects of other components of rotenone formulations (organic solvents, permanganate) in the environment should also be investigated.
- While application of rotenone from the headwaters of all drainages in a watershed may be necessary to eradicate unwanted fish, this practice may also ensure that any recolonization from drift (organisms floating downstream with the current) of resident invertebrates is

impossible. Elimination of this potential headwater refuge is likely to favor recolonization by "weedy" species, i.e. those that disperse and colonize rapidly by flight and thrive in disturbed habitats. Species that are less vagile and have restricted distributions are vulnerable to local extinction. The headwaters of streams may be reservoirs for rare and/or sensitive species of invertebrates (possibly undescribed species) and should be given special attention in pre-project surveys.

- Though bioassessment studies are useful for quantifying impacts if before/after comparisons are made (at impact and control sites), such monitoring alone does not address the fate of rare species, so complete invertebrate surveys should also be done.

The bottom line is that the potential for irreversible damage exists and recolonization of a rotenone-treated stream is at best uncertain. Such uncertainties argue that the practice of using rotenone to remove undesirable fish from streams should be undertaken only with great caution and with the benefit of pre-project surveys and pilot studies on treatment impacts and recolonization dynamics for the particular drainages under consideration. Management of streams for single species, whether listed or not, should not jeopardize the very ecosystems and biological communities into which such populations are being introduced. Aquatic habitat management needs to be sensitive to retaining or restoring multiple species and ecological function. Treatment of entire watersheds from headwaters sources should not be undertaken until pilot studies of recovery on smaller reaches have been done. This is needed to evaluate the "ecological safety" of the treatment and determine whether goals/objectives have been met. In conclusion, I believe that the Lahontan Basin Plan objective for species composition needs to be met to protect stream ecosystems, and feasibility studies, monitoring, and inventory should also be conducted to ensure compliance. Amendment of the objectives to allow longer recovery times may then be considered if the studies so warrant. This will ultimately assure that threatened fish species are established in viable natural ecosystems.

Yours Sincerely,

David B. Herbst

Linda S. Adams
Secretary for
Environmental Protection

California Regional Water Quality Control Board
Lahontan Region

Arnold Schwarzenegger
Governor

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Ex. C

JUL 0 3 2006

Robert D. Williams, Field Supervisor
Fish and Wildlife Service
Nevada Fish and Wildlife Office
1340 Financial Blvd., Suite 234
Reno, NV 89502

ROTENONE SCOPING COMMENTS FOR SILVER KING CREEK NEPA DOCUMENT

Thank you for the opportunity to provide scoping comments for the preparation of an Environmental Impact Statement (EIS) for the proposed Paiute Cutthroat Trout Restoration Project in the Carson-Iceberg Wilderness, Humboldt-Toiyabe National Forest, Alpine County, California. This project may have a significant effect on the environment and these effects both short term and long term must be analyzed in accordance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). This letter contains a number of enclosures containing evidence and concerns related to the potentially significant environmental impacts.

The Lahontan Regional Water Quality Control Board (Water Board) adopted a Water Quality Control Plan for the Lahontan Region (Basin Plan). The Basin Plan contains water quality objectives requiring that waters of the region shall not contain detectable levels of pesticides. The Basin Plan further provides for variances to be granted to the Department of Fish and Game for fish recovery projects if certain conditions can be met. Since the U.S. Fish and Wildlife Service (USFWS) is lead on this project, the Water Board may need to amend its Basin Plan to consider variance criteria for the USFWS for the proposed project. If Department of Fish and Game was the co-lead on the project, the Water Board may be able to use the existing criteria in the Basin Plan. Because the Water Board has to take discretionary action to grant a variance for the project, we need an environmental document that complies with the CEQA. A CEQA Lead Agency must still be identified. Because NEPA does not require separate discussion of mitigation measures, these points of analysis will need to be added, supplemented, or identified before the EIS can be used as an EIR. CEQA requires that the State Lead Agency shall consult as soon as possible with the Federal Lead Agency. We will need to meet with you and the Department of Fish and Game as soon as possible to discuss joint environmental document preparation.

Water Board staff has commented extensively on the 2002 Department of Fish and Game mitigated negative declaration (Kemper, 2002) and on the US Forest Service Environmental Assessment for this project (Churchill, 2002) and our comments are enclosed.

This project has been highly controversial and litigious. Most recently, the US District Court in Californians for Alternatives to Toxics v. US Forest Service on August 31, 2005 imposed an injunction. The proposed EIS must adequately address the issues raised in this lawsuit, our previous comments, and other comments on the proposed use of rotenone in the Silver King Creek watershed.

There are four issues requiring further evaluation in the EIS.

1. Rare, Unique, and Endemic Species: The primary issue in the most recent lawsuit and in the Water Board comments is the potential destruction of non-target rare and endemic species. Since many of these streams and headwater areas are isolated, there is the potential for rare and endemic species unique only to these waters. No evidence has been produced to date that any comprehensive biological survey has been done within the project area to assess whether any rare, unique and/or endemic species exists. Simply saying that they have not been observed, so they must not exist—as the defendant did in the above case—is not adequate, since if the project proponent is mistaken, an elimination of a unique species may occur from the rotenone application. At least two years of complete biological surveys to the species level should be conducted in these remote streams and headwater areas prior to commencement of any rotenone project. The draft EIS should provide a detailed survey plan and contingency measures to address protection of any rare species that could be adversely impacted from the rotenone treatment. This may require that alternatives to rotenone be considered for non-native fish species eradication in the areas that provide habitat for any rare or unique non-target species.

2. Short- and Long-Term Effects on Aquatic Community Composition: General toxic effects of rotenone are not strictly specific to fish, but all gill-breathing aquatic organisms. This includes juvenile species of amphibians and larval stages of insects—benthic macroinvertebrates. Studies on effects of rotenone on macroinvertebrates shows a consistent negative effect. Dr. David Herbst, an eminent aquatic biologist with the University of California at Santa Barbara, has the following to say about this regarding prior rotenone treatments and Silver King Creek:

   "Data suggest that (rotenone) treatments produced (1) a persistent high level of community dominance (a sign of stress at one taxon comprised 60-75% or more of all organisms relative to 20-35% before treatment), (2) transient loss of about 50% or more of EPT taxa (sensitive mayfly-stonefly-caddis taxa) during treatment years, followed by three years until levels had apparently recovered, and (3) persisting loss if stonefly taxa relative to pretreatment levels, with an especially notable loss of the abundant Peltoperlid *Yoraperia* through the post-treatment period."

He summarizes that "the potential for irreversible damage exists and recolonization of a rotenone-treated stream is at best uncertain...Management of streams for single species, whether listed or not, should not jeopardize the very ecosystems and biological communities into which such populations are being introduced."

Furthermore, when comparing pre- and post-rotenone treatment macroinvertebrate data, reliance on some standard metrics may be misleading because they may not (a) account for re-colonization with the same species that were present before treatment—other similar species or even genera could substitute; and (b) total macroinvertebrate abundance does not measure community structure. Metrics such as biotic index or a community similarity index will provide better information regarding post-treatment effects. If headwater areas are treated, re-colonization from drift of indigenous invertebrates is eliminated, and the stream will be re-colonized by more opportunistic and vagile species (those that disperse and colonize rapidly by flight and compete well in disturbed habitats). See Enclosure 7 for complete copy of Dr. Herbst's comments.

3. Other Toxic Compounds in Rotenone Formulations: Commercially available rotenone also contains toxic cube resins such as deguelin, piperonyl butoxide, and/or other carcinogenic compounds (See table in Enclosure 1). These compounds have also been shown to be toxic to macroinvertebrates, and should likewise be assessed along with rotenone in any rotenone formulation studies involving toxicity to macroinvertebrates.

4. Alternatives to Rotenone, Both Chemical and Non-Chemical: A chemical alternative to rotenone is antimycin, which has a persistence in the environment of hours compared to days or weeks with rotenone. Additionally, macroinvertebrate recovery is apparently much more rapid after application and it is more species-specific than rotenone. Many Federal resource management agencies have taken to using antimycin for species reintroduction projects as a result.

   Electroshocking in combination with gill netting has been a very effective non-chemical method for removing fish from lakes. This has been used successfully in 22 lakes for non-native fish removal projects in Sierra Nevada Mountains (Knapp and Matthews, 1998; Beecher, 2005).

   Detonation cord has likewise been successful in a number of recent DFG trials in the Sierra Nevada mountains (D. Becker, Associate Biologist, DFG, personal communication, 2006).

Please carefully review and evaluate all of the enclosed materials for consideration in the Environmental Impact Statement for the proposed project. We request that you consider several alternatives including limited rotenone use coupled with other measures to remove non-target species, and no rotenone use. Project contacts for this project are Dr. Bruce Warden, Environmental Scientist at (530) 542-5416 and Lauri Kemper, Division Manager at (530) 542-5436.

Harold J. Singer
Executive Officer

Enclosures:
1. Table 1 - Expected Chemical Concentrations of Rotenone formulations
2. Erman, Nancy and Don, 2006. *Comments on EPA Rotenone Risk Assessment* to USEPA.
3. Singer, 2005. *Regional Board Comments on State Water Board draft Order..., SWRCB/OCCFileA-1669 and A-1699(a)*, to Debbie Irvin, Clerk to State Board.
4. Kemper, 2004. *Follow-up to National Pollutant Discharge Elimination System (NPDES) Permit Hearing for Silver King Creek Rotenone Project, Alpine County*, to Banky Curtis, Regional Manager, DFG.
5. Kemper, 2004. *Updated Project Information Needed for Proposed 2004 Rotenone Treatment, Silver King Paiute Cutthroat Restoration Project, Alpine County*, to Banky Curtis, DFG.
6. Churchill, 2004. *Comments on Draft Revised Recovery Plan for Paiute Cutthroat Trout, Silver King Creek Rotenone Treatment, Alpine County*, to Reno FWS.
7. Herbst, 2002. *Comments on Draft Negative Declaration for Paiute Cutthroat Trout Habitat Restoration Project*, to State Clearinghouse
8. Kemper, 2002. *Comments on Mitigated Negative Declaration, Paiute Cutthroat Trout Habitat Restoration Project, State Clearinghouse #2002052136* to William Somer, DFG.
9. Churchill, 2002. *Comments on New Environmental Assessment, Silver King Creek Paiute Cutthroat Trout Restoration Project/Rotenone Treatment, Alpine County* to Jim Harvey, USFS.
10. Knapp, R.A. and K.R. Matthews. 1998. Eradication of Nonnative Fish by Gill Netting from a Small Mountain Lake in California. *Restoration Ecology* 6(2):207-213.
11. Becher, B. 2005. Frogs Trump Fish. *Los Angeles Times*, August 16, 2005

cc: Neil Manji / California Department of Fish and Game, Rancho Cordova
Nancy Erman
Laurel Ames
Dave Herbst

BW/adw t:\ FWS Rotenone NEPA Scoping Comments.doc

Ex. D 197

Memorandum

To : Mr. William Somer
Wild Trout Biologist
Sacramento Valley - Central Sierra Region

Date : November 8, 2000

From : Department of Fish and Game : George Heise
Native Anadromous Fisheries and Watershed Branch

Subject : Fish Barrier Inspection - Silver King Creek, Alpine County

This memorandum documents my opinion on the competency of certain natural geologic streambed features in Silver King Creek to act as barriers to the upstream movement of trout. You and I visited the barrier site on September 27, 2000 and were accompanied by Mr. Richard Flint, Fisheries Biologist, Sacramento Valley - Central Sierra Region, Mr. Pat Shanley of the Forest Service, and Mr. Jim Harvey of the Fish and Wildlife Service.

The site in question is located on Silver King Creek, Alpine County, at GPS coordinates of N 38°- 31.27' and W119°- 35.68'. The stream reach in this vicinity passed through a narrow gorge and is characterized by a high gradient channel with large boulders and numerous vertical drops in excess of 5 feet. The primary feature of the barrier is a waterfall that has been created by a huge boulder (20 feet or more) that was deposited in the channel. The boulder is surrounded by other large boulder streambed features and bedrock canyon walls. The result is a complex waterfall which drops approximately10 feet vertically on the left side of the main boulder and cascades through a tightly spaced series of smaller drops around the right side of the boulder, over a distance of 20 to 30 feet. Two smaller, yet significant, falls/barriers are located down stream. These features correspond to barriers 1, 2, and 3 in your November 10, 1994 memo. You noted at the primary barrier that, when compared to your previous visits to this site, it appeared that the falls on the right side of the boulder have been degraded by the erosion and loss of bed materials from the top of the falls.

After viewing the primary falls barrier and the associated smaller barriers, it is my opinion that, in combination, these features <u>most likely</u> constitute a total battier to fish passage. I can not, however, say it does with absolute certainty.

In theory, a trout with a darting swim speed of 14 feet/second (fps) can only jump to a height of three feet. When the vertical velocity component of a standing wave from which a fish might leap is added to the darting speed of the fish, the jump will be somewhat higher, perhaps as much as five feet for an exit velocity of 18 fps. Six vertical feet is generally assumed to be a total barrier to trout passage. These theoretical jumping limits are based on ideal hydraulic conditions, such as, a simple fall into a deep pool with a large volume for dissipating the energy of the falling water.

An important aspect to consider when evaluating potential barriers during low flow conditions is what effect high runoff conditions will have on the magnitude of the barrier. A vertical fall of eight feet may be reduced to two or three feet when the stream rises to flood levels. Evidence of high flow at the subject barrier site suggests that the flood flows could be four to six feet, or more, in depth. This could reduce the fall height at the barriers to a height that could conceivably be jumped under ideal conditions.

Another important consideration when evaluating the integrity of a barrier is the level of air entrainment and turbulence that is being generated by the falling water. Air entrainment reduces the apparent density of the water which, intern, reduces the fishes locomotive ability. Excessive turbulence in the flowing water will keep a fish disoriented and prevent it from setting up for a jump.

It is my opinion that under low flow conditions, the vertical magnitude of the individual barriers will prevent the upstream movement of the resident fish. Under high flow conditions, the vertical magnitude of the barriers is reduced, but, due to the narrowness of the gorge and the steepness of the stream channel, it is my opinion that the excessive air entrainment and turbulence in the flowing stream will continue to prevent fish from moving upstream through the barrier reach.

Since the barriers in question on Silver King Creek are within a vertical magnitude that could conceivably pass trout under ideal conditions, and since they have multiple flow paths and I have only viewed them under low flow conditions, I have to acknowledge that there may be a remote chance that the right fish, at the right place, at the right flow, might get lucky and pick it's way upstream. But I think this would be a very remote chance.

Please give me a call at (916) 653-2189 if I can be of additional assistance..

George Heise

George Heise
Senior Hydraulic Engineer

cc: Mr. Patrick O'Brien - SVCSR
Mr. Richard Flint - SVCSR
Mr. Chuck Knutson - FPB

DWRRIER COSTS

Kern River Schoper } 1.6 million - DWR - out to bid

contingency 150 - 300 K

Kern River Barrier - Templeton
220,000 - direct costs
≈$400,000 w/ DFG Personnel

COST OF A TREATMENT MAY FALL WITHIN THE CONTINGENCY COST OF A BARRIER PROJECT

A BARRIER IN THE SILVER KING GORGE MAY COST 1.5 MILLION

Ex. E

Lahontan Cutthroat Trout Restoration Project – Upper Truckee River

Project Proponent: US Forest Service; Lake Tahoe Basin Management Unit

Project Leader: Richard Vacirca; Forest Fishery Biologist
rvacirca@fs.fed.us/530-543-2768

Background

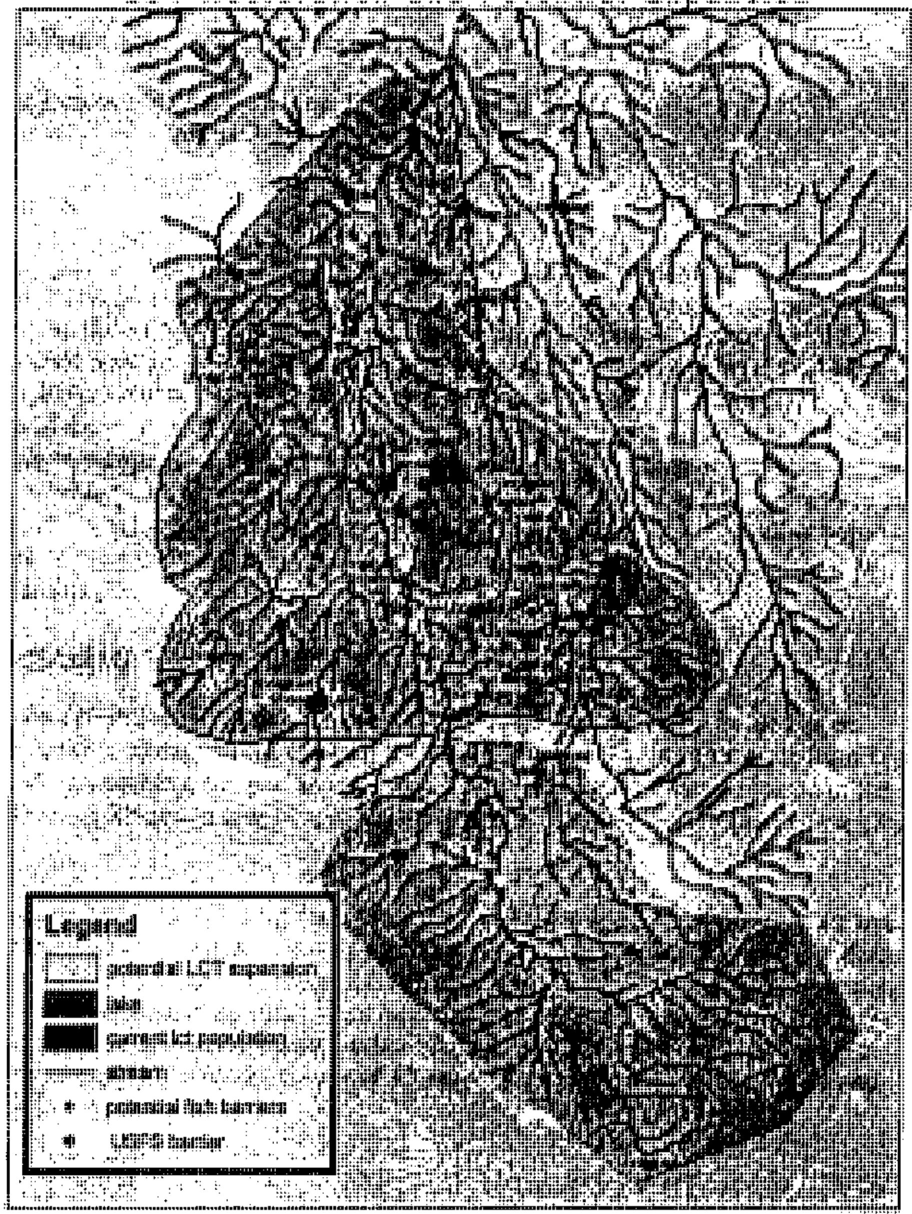
Lahontan cutthroat trout (LCT) were introduced to the headwaters of the Upper Truckee River in Meiss Meadows in the late 1980's and early 1990's through a cooperative effort between the California Department of Fish and Game, US Forest Service and US Fish and Wildlife Service. Non-native brook trout were initially removed from the Upper Truckee River prior to the LCT introduction by means of rotenone application. However, because of the extensive wet meadow conditions throughout the Meiss area, brook trout were able to escape from the initial removal effort. Since that time brook trout removal has occurred by utilizing manual electrofishing methods. Recent removal efforts in 2007 discovered brook trout were no longer in the headwaters. The Meiss Meadow population is one of the only high-elevation meadow populations of LCT in the Sierra-Nevada Mountain Range.

Proposed Action

It has been determined important to continue the brook trout removal in the Upper Truckee River to a) expand the existing LCT population by reducing impacts from non-native fish competition, b) provide a source LCT population to lower segments of the Upper Truckee River and Lake Tahoe and c) enhance native fisheries opportunities for anglers.

A combination of electrofishing and gill netting to remove introduced brook trout and rainbow trout will occur within the Upper Truckee River from the bottom of the Meiss Meadows Lahontan Cutthroat Trout (LCT) reclamation reach to the natural fall structure in section 19 and associated small lakes (see attached map). Gill netting will occur in small lakes and stream pools where electrofishing is not feasible. The project will be implemented annually over the course of 15 years by utilizing US Forest Service and CAFG field crews.

LCT Restoration and Potential Expansion



Comments on proposed NPDES permit for poisoning Silver King Creek and tributaries. March 22, 2010

Don C. Erman and Nancy A. Erman

We have not had time to analyze and compare the Final EIR released by CDFG on March 16, with this NPDES permit. Information not in previous documents is in the Final EIR. We are requesting that the hearing on this permit be postponed until June 9-10 meeting of the Lahontan Board in South Lake Tahoe.

Incorrect statement regarding historic range of Paiute Cutthroat trout

P. 2 Suggest you remove the last part of the first sentence, ..."all of which comprise the historic range of the fish." There is no scientific evidence that this subspecies of Lahontan CT, the Paiute CT, ever inhabited the area below Llewellyn Falls, except for those fish that may now wash over the falls. It was originally collected and described from above Llewellyn Falls on or about 1933. That is what science considers its "type locality." See our comments on the FWS Recovery Plan, March 20, 2004, in Lahontan files).

Misleading and incorrect statement about "rotenone."

We have commented on the toxicity of rotenone repeatedly in past documents already in the Lahontan Board files; but because the NPDES permit still contains misleading language concerning this poison, we will review that information again.

The NPDES permit states that "rotenone is a naturally occurring pesticide found in the roots of certain plants. It is used for insect control and for fisheries management."

In fact, rotenone has been withdrawn for all terrestrial use (insect and/or invertebrate control) in the U.S., Canada, and the European Union. The EPA asked the companies that produce rotenone to submit evidence on the neurotoxic affects of rotenone on humans. The companies chose to withdraw from the market the products containing rotenone rather than supply the data. Many

EXHIBIT 6

studies over the past 10 years have shown a connection between rotenone and Parkinson's disease.

The only use of rotenone now is as an aquatic poison to kill fish. It does indeed kill aquatic insects, other aquatic invertebrates, and amphibians at the same time it kills fish.

The formulations of rotenone being used are not "natural" products, as implied in the statement above in the NPDES permit. They are complicated formulations of many chemicals. CFT Legumine, the rotenone formula proposed for the Silver King poisoning has twice as much rotenone and twice as much other cube resins as the Nusyn-Noxfish formula, used in the past, as well as large amounts of other chemicals described later in the NPDES permit (section 8).

To continue calling rotenone a natural pesticide, as if somehow that makes it harmless, is disingenuous and should be omitted from the permit. Cyanide is also a natural poison. So is arsenic. Mercury is natural. Do we want these added to the unspoiled waters of our Wilderness Areas?

Basin Plan Requirement for restoration of invertebrate species

We think language in the DFGs Programmatic EIR Rotenone Use for Fisheries Management, 1994, requires that invertebrate species composition be restored within one-year following poisoning of streams/lakes. The paragraph labeled 4 at the top of the page on p. 14 (NPDES permit) states that "Whenever the language contained in the above mentioned documents [Basin Plan or DFG Programmatic EIR…] may overlap, the requirements that will provide the most restrictive protection of water quality shall apply."

We find the same requirements in Ch 3 Water Quality Objectives, Lahontan Basin Plan, p 3-11. But at 4.9-25-3 in the same document we find another standard for restoration of beneficial uses within two years. We have not had time yet to analyze the newest plan for monitoring released last week by the DFG in the final EIR. Clarification is needed on which standard you are using for restoration of species composition.

No pre-project inventory of aquatic invertebrate species has yet been conducted. Thus, there is limited basis for determining whether or not species conditions in either the Basin Plan or the Programmatic EIR for Rotenone Use will be met. The DFG and FWS now have finally admitted that past poisoning projects had impacts of at least three years, as we contended before and at the time of the 2004 hearing on an NPDES permit for this same project. These results would qualify as "long-term" whether you use one year or two years for recovery period.

"The Agencies agree that Trumbo et al. (2000 a, b) found impacts on invertebrates three years following the 1993 Silver King Creek rotenone treatment and that impacts on invertebrates were still evident two years after the final Silver Creek rotenone treatment" (p. F-87, section 2-19 response to comments, FEIR)

The CDFG misrepresented results of past monitoring to the Lahontan Board during the 2004 hearings. And their statement became part of the 2004 proposed NPDES permit as Attachment 2: "No evidence of long-term impacts were found in either study" (referring to Trumbo et al. 2000a and 2000b studies on Silver King Creek and Silver Creek) (Proposed NPDES permit, July 8, 2004, Attachment 2, Interagency Study Proposal, June 15, 2003).

In reference to this past misrepresentation of data and results, we note the specific wording and conditions at 14, p. 3, Standard Provisions for NPDES Permits that were attached to the 2004 permit. The same conditions are included in the present permit as attachment B, p 3, number 14.

Incorrect assumptions in NPDES permit regarding invertebrate "refugia."

We have commented extensively on this issue in past documents that the Board should have on file. But once again misstatements have found their way into the permit. Invertebrates occupy specific microhabitats within a stream system. They are not everywhere present throughout a stream system. They are distributed by species along a stream gradient. All but the most widely distributed species are replaced rather than added to from upstream to downstream. Extensive research has been done on this topic since the 1940s. We can supply you with published species-level studies that we have conducted on Sierra streams. Statements made in this NPDES permit that upstream areas will serve as refugia to re-colonize downstream areas are fundamentally false. Only a small percent of species would be able to exist throughout the stream system.

Data have been supplied by the DFG and FWS (the Agencies) (Draft EIR/S) that prove this point:

Similarity of Upstream (unpoisoned) Stations to Downstream Stations:

The NPDES permit accepts the Agencies' claim that upstream, unpoisoned sites have species of invertebrates that will colonize and replace the same species lost through poisoning downstream. The Agencies have provided no data from Silver King Creek to substantiate that claim. There is only one unpoisoned station sampled (for which we have seen data) as recently as 1996, Four Mile Canyon Creek.

Here is a comparison of the similarity of invertebrate composition of Four Mile Canyon Creek (elevation 8440') from 1996 and a new invertebrate station SK 8 sampled in 2006 (the last year for which we have seen data from 2003-2006) that will be poisoned if the latest project is approved. Station SK 8 is the most downstream station on Silver King Creek (elevation about 7880') below Llewellyn Falls and about 0.5 miles above the junction with Tamarack Creek.

In the monitoring from 1990-1996, the Agencies sampled 5 stations on Silver King Creek above Llewellyn Falls and one (control) station on Four-Mile Canyon Creek. Beginning in 2003 through 2006, all stations on Silver King Creek were changed, and 8 stations were sampled: 4 above Llewellyn Falls and 4 downstream.

To make this comparison we used a common ecological index of taxonomic similarity, the Jaccard Coefficient (Cj). This similarity coefficient is calculated by dividing the number of "species" in common between both stations (a) by the number of "species" in one station (b) plus the number of species in the other station (c) minus the number of species in common to both (a) times 100

$$Cj = a/(b+c-a) * 100$$

The definition of "species" in this context should be some taxonomic level that is distinctive: we have used the taxa level listed in the Agencies data tables as "subfamilies, genus, and species".

	4-Mile Canyon 1996	SK 8 2006	
Total Operational Taxonomic Units	44	45	
No. subfamily, genus, species	32	32	
No. Identified to species	5	8	
Taxa in common			12

$$Cj = 12/(32+32-1$$

$$=12/52$$

$$=23\ \%$$

Therefore, even at low taxonomic resolution (mostly genera and subfamilies, NOT species) only 23% of the taxa are present in upstream refugia of Four Mile Canyon Creek to replace what is lost downstream in Silver King Creek by poisoning.

In terms of species level analysis, there were 11.4 — 17.8 % of the Operational Taxonomic Units (which is the same as the term "total taxa" used in the Agencies' analyses) identified to species.

<u>Rotenone Testing of CFT Legumine used in Lake Davis Tributaries 2007:</u>

<u>Implications for Silver King Creek and NPDES permit:</u>

The report by McMillin and Finlayson 2008 is cited in the proposed

NPDES permit for methods of analysis of CFT Legumine constituents. It presented results and methods used in analysis of some active and inactive ingredients of CFT Legumine for the poisoning of Lake Davis and tributaries in 2007. We present here some implications of their report to the proposed project and NPDES permit for Silver King Creek. Only on March 16, 2010, were we informed in a Final EIR what chemical was actually to be applied.

We note first that the analysis of components in the rotenone formulation CFT Legumine is incomplete in their report (and in the Proposed NPDES permit and in the consultants report to CDFG by Fisher 2007). The Active Ingredient "Other resins" (other rotenoid compounds that "have some active role in controlling the pest") was not tested or measured. (In previous submissions we have presented literature and discussion of the compounds in "Other resins" and their known toxicity.) The Proposed NPDES permit for Silver King Creek does not identify, set discharge levels, or plan monitoring of this pesticide active ingredient as it should. We request the staff of Lahontan Board to verify Active Ingredients in CFT Legumine by examining specimen labels or the CFT Legumine materials sheet and revise the permit for monitoring and compliance.

Likelihood of Exceeding Label Requirements

Based on the most recent evidence, and the only example we know in California, we believe application of CFT Legumine in Silver King Creek cannot meet EPA label requirements for rotenone. CDFG applied poison on two separate occasions to tributaries in three drainage basins of Lake Davis (McMillin and Finlayson, 2008). Data in the report from Appendix I included rotenone concentrations for 70 samples (excluding four samples with no data), 38 from the first poisoning September 10-13, 2007, 32 samples from the second poisoning from September 25-26, 2007, and 10 samples 12-14 days after the first poisoning of tributaries and immediately before the second poisoning. The application rate of rotenone for the tributaries was designed to be 51 and 102 $\mu g/L$ rotenone from CFT Legumine. CDFG took samples within 2 hours of application at a number of stations distributed along each tributary, but no information was presented in the report on where samples were taken relative to poison stations.

The data from Appendix I show that CDFG was unable to apply the poison at the target concentrations. Of the 70 samples, 30 (42.9 %) exceeded the highest designed level of 102 $\mu g/L$. Five of the six mean values for three streams and two poison applications exceeded 51 $\mu g/L$. A total of 15 of the 70 reported values (21.4 %) were greater than the theoretical solubility limit of 200 $\mu g/L$ for rotenone. At 5 sites, the concentration of rotenone was 1,392 to 2,414 % higher than the upper design level. McMillin and Finlayson (2008) suggested that the extreme values of rotenone were due to collecting samples too early or before complete mixing of stream water with poison, especially during the first poison event. They stated "Sampling times were better coordinated during the second treatment to account for mixing…" (p.12) and therefore, fewer high readings occurred. We examined this conclusion and found that although extremely high (>1,000 % of target levels) concentrations did not occur, high concentrations were even more common in the second poisoning. We used a concentration greater than 200 $\mu g/L$ as the threshold (the theoretical solubility limit for rotenone and twice the upper target level chosen for the project) criterion of high values. In the first poisoning 8 out of 38 samples (21%) and in the second poisoning 9 out of 32 samples (31%) exceeded 200 $\mu g/L$. If coordination was improved in the second poisoning, meeting target concentrations was not.

A plot of the rotenone results separated into the three tributaries (Big Grizzly Creek, Cow Creek, and Freeman Creek and two poison applications is given in Figure 1. This plot shows that five of the six mean concentrations were above the 51 $\mu g/L$ target level and four of the six mean concentrations were above the 102 $\mu g/L$ target concentration selected by CDFG.

These results illustrate the inability of CDFG to deliver the poison rotenone in CFT Legumine under field conditions at designed concentrations. Both the number of sites and the frequency of occurrence illustrate that high values were not simply unusual events. High poison concentrations have several implications.

First, the CDFG likely is unable to meet label requirements for the use of rotenone (see below current EPA/FIFRA label requirements). If CDFG/FWS are granted the proposed NPDES permit as presented to poison Silver King Creek at the concentration of 25.5—50.9 $\mu g/L$, we believe, based on the most recent project results at Lake Davis, that a high proportion of the time they will exceed the label restrictions of 50 $\mu g/L$. It also seems unwise to propose an NPDES permit that technically stipulates a violation of the label (i.e., 50.9 $\mu g/L$ rather than the label requirement of 50 $\mu g/L$).

Second, high concentrations can move beyond the location of initial application and pass through stream sections as a "poisonous cloud" even if concentrations are reduced by half through normal breakdown. Regulatory compliance monitoring stations in Silver King Creek identified in the Proposed NPDES permit are only in the vicinity of the most downstream end of the project near Snodgrass Creek. Monitoring stations above Silver King Creek canyon, Tamarack Creek, and Tamarack Lake Creek are required only to take two samples (timing unspecified) and for unidentified purpose other than to insure sufficient chemical for killing. Thus, the true chemical concentrations along most of the extent of Silver King Creek and tributaries will be unmeasured, and compliance with the Proposed NPDES permit to "meet label requirements" will not be verified.

Third, rotenone from CFT Legumine apparently persists in streams and rotenone is deposited in sediments where, according to McMillin and Finlayson (2008), it decomposes more slowly than in open water. As they pointed out for their lake samples "The most persistent constituent of the CFT Legumine™ in sediment was rotenone. Rotenone persisted in sediment for up to six months" (p. 20).

Their data for tributaries (Appendix 1) also suggested persistence of rotenone in the streams. After 12-14 days the three tributary streams were poisoned a second time in 2007. Water samples from 10 locations on Big Grizzly

Creek immediately before the second poisoning averaged 19.5 $\mu g/L$ rotenone and 59.8 $\mu g/L$ of rotenolone. Because no poison had been applied to the streams for 12 to 14 days, we assume that rotenone was slowly released from bottom sediments back into the water column and there is a behavior of CFT Legumine that is unexplained and unknown at present. There are no provisions in the NPDES permit for frequent enough water sampling above Silver King Creek canyon that might detect the behavior of rotenone in the main reaches poisoned. The Proposed NPDES permit also presents no alterations of CFT Legumine application methods that avoid this problem.

Finally, all the actual values from field samples in the Lake Davis project were higher (on average 16 % higher) than actually reported. This conclusion follows from the findings given by McMillin and Finlayson (2008) who reported results of laboratory testing of compound recovery of major constituents in CFT Legumine (Appendix A, Table 5). After fortification, they tested compound recovery at concentrations of 2, 10, 50, and 100 $\mu g/L$ rotenone. We found no difference ($p>0.05$, ANOVA) in the percentage recovery of rotenone at the four levels of Lake Davis water, and the average recovery from all tests combined was 83.9 %. No samples equaled or exceeded 100 % recovery. Therefore, reported monitoring values, with the same techniques reviewed in this proposed NPDES permit and reported by McMillin and Finlayson (2008), may be expected to be 16% lower than actually occur. We have not adjusted the data, nor did McMillin and Finlayson (2008), for the three tributaries but it is clear that the true concentrations of rotenone exceeded the target values even more than what was reported.

New EPA Label Requirements

Poisoning of Lake Davis and its main tributaries took place in September 2007. On March 31, 2007 the US EPA released its Reregistration Eligibility Decision for Rotenone (RED for rotenone). That decision required changes to labels for all piscicidal uses of rotenone. Included in these changes were separate maximum treatment concentrations for lakes and streams (US EPA 2007):

Restrictions for all Formulations	"The Certified Applicator supervising the treatment must remain on-site for the duration of the application." "Do not allow recreational access (e.g., wading, swimming, boating, fishing) within the treatment area while rotenone is being applied." "In lakes/reservoirs/ponds, do not apply this product in a way that will result in treatment concentrations greater than 200 parts per billion." "In streams/rivers, do not apply this product in a way that will result in treatment concentrations greater than 50 parts per billion."

Although the poisoning of Lake Davis occurred in September after the release of the new label requirements in March 2007, the CDFG apparently chose not to follow the new requirements. As McMillin and Finlayson (2008) noted in their report, the designed treatment concentrations for tributaries were 51 to 102 $\mu g/L$ of rotenone.

We request that any NPDES permit for the use of pesticides include a specimen label so that the public may review requirements with actual permit language. We also request that staff from the Lahontan Board review the entire 2007 RED for rotenone cited above and ensure that monitoring and reporting are sufficient to meet regulatory compliance of label requirements. At present, the permit is deficient. The permit should also be modified to include monitoring and regulation of all active ingredients.

(see attached figure below)

References:

Fisher, J.P. 2007. Screening level risk analysis of previously unidentified rotenone formulation constituents associated with the treatment of Lake Davis. Environ consultants, prepared for California Department of Fish and Game, September, 2007.

McMillin, S. and B.J. Finlayson. 2008. Chemical residues in water and sediment following rotenone application to Lake Davis, California 2007. California Department of Fish and Game, Pesticide Investigations Unit, OSPR Administrative Report 08-01, Rancho Cordova, California.

US Environmental Protection Agency. March 31, 2007. Reregistration eligibility decision for rotenone. EPA 738-R-07-005.

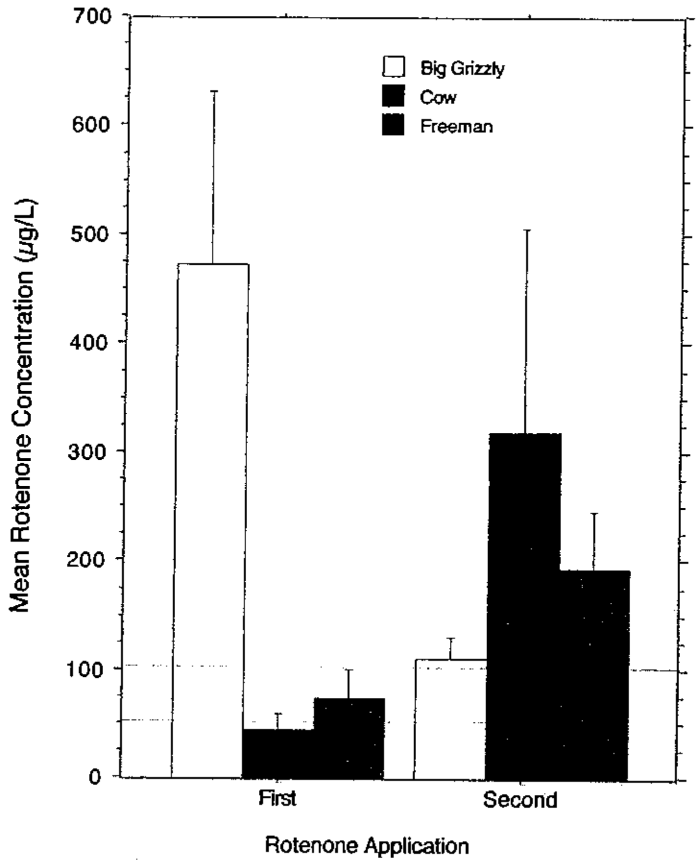


Figure 1. Mean rotenone concentration in three tributaries of Lake Davis, Sept. 2007 (from McMillin and Finlayson 2008). Horizontal lines indicate design concentrations of 51 $\mu g/L$ and 102 $\mu g/L$.

From: Nancy A. Erman <naerman@ucdavis.edu>
Subject: **Silver King/rotenone/NPDES permit**
Date: March 22, 2010 5:41:55 PM PDT
To: bwarden@waterboards.ca.gov
1 Attachment, 292 KB

Bruce,

Attached are further comments on the NPDES permit.

Nancy Erman

letr.-Lahont... .pdf (292 KB)

RESTRICTED USE PESTICIDE
Due to aquatic toxicity
For retail sale to, and use only by, Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

CFT Legumine™

Fish Toxicant

For Control of Fish in Lakes, Ponds, Reservoirs, and Streams

ACTIVE INGREDIENTS:	
Rotenone	5.0% w/w
Other Associated Resins	5.0%
OTHER INGREDIENTS[1]	90.0%
Total	100.0%

[1] Contains Petroleum Distillates

CFT Legumine is a trademark of CWE Properties Ltd., LLC

KEEP OUT OF REACH OF CHILDREN
WARNING

FIRST AID	
Have product container or label with you when obtaining treatment advice.	
If swallowed	• Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice. • Do not give any liquid to the person. • Do not anything to an unconscious person • Do not induce vomiting unless told to do so by the poison control center or doctor.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
If inhaled	• Move person to fresh air. • If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
Note to Physician: Contains Petroleum Distillates. Vomiting may cause aspiration pneumonia. For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.	

EPA Reg. No. 75338-2 EPA Est. No. 655-GA-1
Manufactured for CWE Properties Ltd., LLC, P.O. Box 336277, Greeley CO 80633

EXHIBIT 7

Date: May 6, 2010

To:
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Re: Comments/ Final Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) for the Paiute Cutthroat Trout Restoration Project, Carson-Iceberg Wilderness, Humboldt-Toiyabe National Forest, Alpine County, CA. Rotenone poisoning in the Silver King Creek watershed.

We are filing these comments on this EIS/EIR as private citizens, in the public interest.

We have commented on this project at every opportunity since 2002. We incorporate by reference all of our previous comments and letters in the files of the California Department of Fish and Game (CDFG), the USDA Forest Service (Forest Service), the U.S. Fish and Wildlife Service (FWS), the Lahontan Regional Water Quality Control Board (LRWQCB), the California State Water Board, the Environmental Protection Agency (EPA), and the Federal Court.

EXHIBIT 8

The project should be denied for the following reasons:

1) This poisoning project will cause long-term harm to non-target species in a designated Wilderness Area.

2) The project is not necessary to protect the Paiute cutthroat trout.

3) The project is not a "recovery effort". It is an effort to establish a fishable population of Paiute CT and add it to a "Heritage Trout" Fishing contest.

4) No scientific evidence exists to indicate that Silver King Creek below Llewellyn Falls is the native habitat of the Paiute CT.

5) It is not known if the series of small falls at the lower end of Silver King Canyon are a barrier to upstream fish migration.

6) Non-native fish can be removed by mechanical species-specific means that do not harm other native species and disrupt aquatic and terrestrial food webs. If the Agencies had begun using mechanical removal of non-native fish eight or ten years ago, they would now have accomplished their goal and saved the people of California a great deal of money.

7) The Paiute cutthroat trout (Paiute CT) is less threatened now than ever in its natural condition. It exists in many isolated and separate populations, at least five of which are in the Silver King Creek Basin at present.

8) It is possible to collect adult invertebrate forms and make a pre-project inventory of aquatic macroinvertebrate species and could have been accomplished by now during the last eight or ten years the Agencies (CDFG, FWS, and the Forest Service) have been planning this poisoning project.

Since 2002, more details of the project have been revealed with the preparation of, first, an Environmental Assessment and now a full EIS/EIR. The likely impacts appear to be greater than first understood. Our comments in 2002, and 2004 suggested impacts to non-target species might be three or four years. But with the revelations of the data from the monitoring of the 1991-93 poisoning in Silver King Creek, we know that impacts to the non-target invertebrate community lasted for at least six years from the time of the first poisoning and undoubtedly longer. Impacts were still clearly evident when monitoring ended in 1996.

The impacts to invertebrates lasted at least three years after the last poisoning in Silver King Creek and the poisoning was done for three years. The invertebrate populations and the food webs, both aquatic and terrestrial, that depend on them were impacted for at least six years and probably longer. The most abundant stonefly genus prior to poisoning was nearly gone three years following the last poisoning, providing evidence that though it was an abundant taxon in the basin, it was highly sensitive to rotenone (Erman and Erman 2006).

In 2000 and in 2003, the California Department of Fish and Game (CDFG) denied that the 1991–93 poisoning had long-term impacts (Trumbo et al. 2000a and an MOU between the Lahontan Regional Water Quality Control Board (LRWQCB) and CDFG, June 16, 2003). As of March 15, 2010, in a response to comments on the EIS/EIR, the U.S. Fish and Wildlife Service (FWS), the USDA Forest Service (Forest Service), and the CDFG (the Agencies) admitted that previous reports to the LRWQCB were false:

> "The Agencies agree that Trumbo et al. (2000 a, b) found impacts on invertebrates three years following the 1993 Silver King Creek rotenone treatment and that impacts on invertebrates were still evident two years after the final Silver Creek rotenone treatment" (p. F-87, section 2-19 response to comments, Final EIS/EIR).

We have no way of knowing when or if these invertebrate populations and species recovered in all locations. Monitoring was not required by the LRWQCB beyond three years at Silver King Creek and two years at Silver Creek. Subsequent invertebrate monitoring studies conducted on Silver King Creek in 2003 to 2006 and in 2007 to the present are not suitable for answering questions about impacts from 1991 to 1996 for all of the reasons that were discussed in detail in comments to the EIS/EIR (Erman and Erman 2009). Further, these later studies were well beyond any reasonable definition of either short-term or temporary.

The Agencies continue to state that no macroinvertebrate species have been identified that are strictly endemic to the Silver King Creek Basin. In fact, no study of macroinvertebrates at the species level has been conducted. Adult specimens must be collected to identify species. The agencies have refused to do such an inventory and have raised many excuses in this EIS for why they cannot attempt such an inventory (Master

Response B, F-1, 2, 3) in Silver King Creek. One excuse is that no species inventory has ever been made prior to rotenone poisoning (FEIS, App. F-3). A species inventory could have been completed in the last eight years since we raised the issue for this project.

Erman, 1996, has been referred to but not correctly understood. We refer the Agencies to the section titled "Limitations and Cautions of Broad Taxa Invertebrate Monitoring" that specifically used an example of rotenone poisoning to illustrate when broad taxa monitoring would not provide an adequate picture of what was happening to existing native species (p. 999–1001) (Ex 1).

Scientific studies must be tailored to the question being asked. One question being asked in a stream poisoning project is what and how many species will be lost? That question cannot be answered only with the broad taxa monitoring that is being conducted for yet a third time in Silver King Creek. We already know the answer provided by broad taxa monitoring of invertebrates in Silver King Creek.

In the same way, the Agencies claim they have not found spring snails in the project area. But no sampling has been done in spring habitats. According to the Final EIS/EIR, springs and seeps will be poisoned if they have a water connection to streams or are believed to have fish in them or to provide a refuge for fish during the poisoning.

The Agencies now claim that a species inventory prior to poisoning would cost $4.5 million. We do not know how they arrived at such a sum, but if that is what it costs to know what species may be eliminated by poisoning this stream in a designated Wilderness Area, then that cost should be added to the cost of the project. The subject of cost raises the questions of how much this project has already cost the public over the past eight or nine years of planning with no results to show for it. If the Agencies had started removing unwanted fish by mechanical means in 2000 or 2001, the project would now be completed, without poisoning the streams, and the Public's money would not have been wasted. Nor would an additional $4.5 million dollars be needed for a study of what species will potentially be impacted by poison.

Eleven macroinvertebrate taxa (families or genera) found in Silver King Creek between 1984 and 2006 are on the California Natural Diversity Database (CNDDB) Special

Animals list. Fifteen species are listed on the CNDDB from those taxa. Until and unless adult specimens are collected and identified, it will not be known if these species occur in the Silver King Creek basin. The CNDDB is a computerized inventory of "the most rare animals, plants, and natural communities in California." It is kept by the Wildlife and Habitat Data Analysis Branch of the CDFG in collaboration with the Nature Conservancy and the Natural Heritage Network (Ex. 2).

The Agencies could conduct a species inventory by collecting adult species in emergence traps and by hand-netting at the stream sites from spring through fall of the year. Few species emerge during the winter only. Black light traps are inappropriate for making an inventory of species from a specific habitat. They are attractants to insects from great distances away and so the aquatic habitat of the insects is unknown, they attract insects that are strong fliers, they trap only insects that can see the black light (many cannot), they do not trap day-flying insects, or non-flying insects (Erman 1989). It may be for these reasons that that Vinson and Vinson 2007 (EIS/EIR, App. D) reported high variability in their attempts to make a species inventory for the Logan River. They used black light traps rather than emergence traps (EIS/EIR, App. F).

The statement by Mangum (EIS 5.1-26, 27) could only be made by someone who did not work at a species level of inventory: "The stream {Silver King Creek] is not unique or isolated, but is typical coldwater stream habitat found through the mountains of the western United States." He further states that "...no unique macroinvertebrates were observed during sample processing of Silver King collections ..." His statements illustrate a common misunderstanding found among those who conduct monitoring studies on larval specimens only and, therefore, at broad taxa levels, as the Mangum laboratory did. He apparently failed to realize that the species in orders, families, or genera differ widely from one area to another. As an example, see Table 2, Erman 1989, (Ex. 3) where the Trichoptera species from Sagehen Creek were compared to species inventories in seven other areas in Western North America.

The Agencies continue to repeat the incorrect assertion that springs and seeps, if not poisoned, can serve as macroinvertebrate refugia for post-project re-colonization. This issue has been refuted several times. Again, the misunderstanding about species and where they live is evident in the EIS. Many species found in springs and seeps do not live farther downstream in the watershed. The Agencies have a confused understanding about the word "refuge" as it applies to springs. Springs are refuges for species from other climatic periods. Springs have constant or near-constant temperatures and so species from warmer or colder climate regimes reside in springs. For these reasons many spring species cannot live farther downstream where temperatures are variable (Erman 1989, Erman and Erman 1990, Erman and Erman 1995). These are also reasons why springs are so important in the consideration of global warming.

We have commented extensively on this issue in past documents that the FWS should have on file. But once again misstatements have found their way into the EIS. Invertebrates occupy specific microhabitats within a stream system. They are not everywhere present throughout a stream system. They are distributed by species along a stream gradient. All but the most widely distributed species are replaced rather than added to from upstream to downstream. Extensive research has been done on this topic since the 1940s. Statements made in the EIS that upstream areas will serve as refugia to re-colonize downstream areas are fundamentally false. Only a small percentage of species would be able to exist throughout the stream system.

Data were in the EIS/EIR that prove this point. We analyzed the similarity of upstream (unpoisoned) stations to downstream stations. The Agencies' claim that upstream, unpoisoned sites have species of invertebrates that will colonize and replace the same species lost through poisoning downstream. The Agencies have provided no data from Silver King Creek to substantiate that claim. There is only one unpoisoned station sampled (for which we have seen data) as recently as 1996, Four Mile Canyon Creek.

Here is a comparison of the similarity of invertebrate composition of Four Mile Canyon Creek (elevation 8440') from 1996 and a new invertebrate station SK 8 sampled in 2006 (the last year for which we have seen data from 2003-2006) that will be poisoned if the latest project is approved. Station SK 8 is the most downstream station on Silver King Creek (elevation about 7880') below Llewellyn Falls and about 0.5 miles above the junction with Tamarack Creek.

In the monitoring from 1990-1996, the Agencies sampled 5 stations on Silver King Creek above Llewellyn Falls and one (control) station on Four-Mile Canyon Creek. Beginning in 2003 through 2006, all stations on Silver King Creek were changed, and 8 stations were sampled: 4 above Llewellyn Falls (in one location) and 4 downstream.

To make this comparison we used a common ecological index of taxonomic similarity, the Jaccard Coefficient (Cj). This similarity coefficient is calculated by dividing the number of "species" in common between both stations (a) by the number of "species" in one station (b) plus the number of species in the other station (c) minus the number of species in common to both (a) times 100

$$Cj = a/(b+c-a) * 100$$

The definition of "species" in this context should be some taxonomic level that is distinctive: we have used the taxa level listed in the Agencies data tables as "subfamilies, genus, and species".

	4-Mile Canyon 1996	SK 8 2006	
Total Operational Taxonomic Units	44	45	
No. subfamily, genus, species	32	32	
No. Identified to species	5	8	
Taxa in common			12

$$Cj = 12/(32+32-1$$
$$=12/52$$
$$=23\ \%$$

Therefore, even at low taxonomic resolution (mostly genera and subfamilies, not species) only 23% of the taxa are present in upstream unpoisoned reaches of Four Mile Canyon Creek to replace what is lost downstream in Silver King Creek by poisoning.

In terms of species level analysis, there were 11.4 — 17.8 % of the Operational Taxonomic Units (which is the same as the term "total taxa" used in the Agencies' analyses) identified to species.

In the current invertebrate monitoring study, stations that were previously poisoned are now being used as control stations. These stations may not contain the species that were native to those areas prior to being poisoned and can not be considered as "controls." To use them as control stations for yet another poisoning in the basin would bias results.

The statements that springs and seeps will be protected are untrue. According to the Final EIS/EIR, springs and seeps <u>will be</u> poisoned if they have a water connection to streams or are believed to have fish in them or are believed to provide a refuge for fish during the poisoning (Final EIS/EIR 3.2.2, p. 3-3; p. 3-8; 4.1.2 p. B-23; 3.2.2.1, p. 3-4; p. 6, Mitigation Monitoring/Reporting Program). Again, the statements in the EIS are made to give the illusion of protection to species and habitats.

It is not reassuring to read that springs and seeps will not be poisoned if they are dry or do not contain enough water for a fish or that Tamarack Lake will not be poisoned if it does not have fish in it. Should the Public assume, then, that dry stream channels and fishless lakes would have been poisoned were it not for Public oversight, a court order in 2005, and the preparation of an EIS?

<u>Rotenone concentrations higher than in 1991–93 poisoning</u>

The current project in Silver King Creek proposes to apply rotenone at approximately 2 to 4.6 times the mean concentration that was measured in the 1991 to 1993 poisoning of the upper parts of Silver King Creek above Llewellyn Falls. Rotenone was measured at a mean concentration of 10.8 $\mu g/L$ for the six poisonings of Silver King Creek in 1991–93 (Table 1, Trumbo et al. 2000a and Flint et al. 1998) and will be applied at concentrations from 25 $\mu g/L$ to 50 $\mu g/L$ in the proposed project (target concentration of 0.5 to 1.0 mg/L CFT Legumine, Final EIS/EIR).

At these concentrations rotenone (CFT Legumine and Noxfish) can be expected to cause the same or greater impacts to non-target species as did the previous poisonings. The EIS/EIR admits the following in response to comments: "Thus the statement of using lower rotenone concentration than have been used in the past on page 5.3-11 was a misstatement and has been corrected" (Final EIS/EIR, p. F-95).

Nevertheless, elsewhere in the Final EIS/EIR, the agencies continue to try to give the impression that they will use lower concentrations of rotenone than in the past (Final EIS/EIR, Ex. A, p. 6: p. 4; Findings and SOC p. 22)

Rotenone concentrations in the stream water will be higher than in the past, not lower.

Problems with CFT Legumine

In 1991 –1993 the CDFG poisoned Silver King Creek above Llewellyn Falls with the rotenone formulation, Nusyn-Noxfish, a formula of rotenone with active ingredients of 2.5% rotenone, 2.5% other cube resins, and 2.5% piperonyl butoxide. They proposed to use the same formulation again in 2002 , 2004, and 2009 (Draft EIS/EIR). That formulation has now been abandoned by the Agencies, apparently because of high environmental risk.

In the current project, the Agencies plan to use CFT Legumine, and the rotenone formulation, Noxfish. (Final EIS/EIR, Response 1-50, p. F-50). (We note that the LRWQCB has not analyzed Noxfish for use in this project in their NPDES permit.) CFT Legumine contains 5% rotenone and 5% other cube resins as active ingredients (Ex. 4). Cube resins have not been analyzed and it is unknown if they are neutralized by potassium permanganate (verbal testimony by Bruce Warden, LRWQCB staff, April 14, 2010, NPDES hearing). Breakdown of deguelin and tephrosin, unlike rotenone, does not produce rotenolone (Caboni et al. 2004). Therefore, monitoring of either rotenone or rotenolone will not account for other cube resins in the active ingredients. Deguelin also has been shown in laboratory tests to elicit the same Parkinson's Disease-like changes in cells as rotenone (Caboni et al. 2004).

In other words, half of the active ingredients in CFT Legumine have not been analyzed or considered in any government document concerning this project. Nor were they discussed in McMillan and Finlayson, 2008, a report that the EIS has relied upon for information.

The Agencies have relied exclusively on a recent study by Finlayson et al., 2010, for a conclusion that CFT Legumine is less toxic to macroinvertebrates than Nusyn–Noxfish (EIS/EIR, p. F-50, F-86, F-96). This study cannot be used to make such a definitive statement. For the six species of invertebrates tested, data for only five statistical comparisons between the two poisons are given. In two of these, the experimental conditions were inadequate for reliable inference because organisms died before the 48-hr. observation. Of the remaining three cases, CFT Legumine was significantly less toxic than Nusyn-Noxfish in the first case; CFT Legumine was not significantly different from Nusyn-Noxfish in the second case; and CFT Legumine was significantly more toxic in the third case.

Rotenone Testing of CFT Legumine used in Lake Davis Tributaries, 2007: Implications for Silver King Creek

CFT Legumine was recently used (2007) in the poisoning of Lake Davis and in all streams, springs, and seeps in the Lake Davis watershed that feed the reservoir. Following is our analysis of the performance of CFT Legumine and the CDFG in that project based on the information given in McMillan and Finlayson 2008, cited in the EIS/EIR:

Likelihood of Exceeding Label Requirements

Based on the most recent evidence, and the only example we know in California, we believe application of CFT Legumine in Silver King Creek cannot meet EPA label requirements for rotenone. CDFG applied poison on two separate occasions to tributaries in three drainage basins of Lake Davis (McMillin and Finlayson, 2008). Data in the report from Appendix I included rotenone concentrations for 70 samples (excluding four samples with no data), 38 from the first poisoning, September 10-13, 2007, 32 samples from the second poisoning from September 25-26, 2007, and 10 samples 12-14 days after the first poisoning of tributaries and immediately before the second poisoning. The application rate of rotenone for the tributaries was designed to be 51 and 102 μg/L rotenone from CFT Legumine. CDFG took samples within 2 hours of application at a number of stations distributed along each tributary, but no information was presented in the report on where samples were taken relative to poison stations.

The data from Appendix I show that CDFG was unable to apply the poison at the target concentrations. Of the 70 samples, 30 (42.9 %) exceeded the highest designed level of 102 μg/L. Five of the six mean values for three streams and two poison applications exceeded 51 μg/L. A total of 15 of the 70 reported values (21.4 %) were greater than the theoretical solubility limit of 200 μg/L for rotenone. At 5 sites, the concentration of rotenone was 1,392 to 2,414 % higher than the upper design level. McMillin and Finlayson (2008) suggested that the extreme values of rotenone were due to collecting samples too early or before complete mixing of stream water with poison, especially during the first poison event. They stated "Sampling times were better coordinated during the second treatment to account for mixing…" (p.12) and, therefore, fewer high readings occurred. We examined this conclusion and found that although extremely high (>1,000 % of target levels) concentrations did not occur, high concentrations were even more common in the second poisoning. We used a concentration greater than 200 μg/L as the threshold (the theoretical solubility limit for rotenone and twice the upper target level chosen for the project) criterion of high values. In the first poisoning 8 out of 38 samples (21%) and in the second poisoning 9 out of 32 samples (31%) exceeded 200 μg/L. If coordination was improved in the second poisoning, meeting target concentrations was not.

We have plotted rotenone results separated into the three tributaries (Big Grizzly Creek, Cow Creek, and Freeman Creek) and two poison applications (Fig. 1). This plot shows that five of the six mean concentrations were above the 51 μg/L target level and four of the six mean concentrations were above the 102 μg/L target concentration selected by CDFG.

These results illustrate the inability of CDFG to deliver the poison rotenone in CFT Legumine under field conditions at designed concentrations. Both the number of sites and the frequency of occurrence illustrate that high values were not simply unusual events. High poison concentrations have several implications.

The Agencies are unable to meet label requirements for the use of rotenone (see below current EPA/FIFRA label requirements). The target concentration for rotenone in the EIS is 25.5—50.9 $\mu g/L$. Based on the most recent project results at Lake Davis, Agencies will exceed the label restrictions of 50 $\mu g/L$ a high proportion of the time.

High concentrations can move beyond the location of initial application and pass through stream sections as a "poisonous cloud," even if concentrations are reduced by half through normal breakdown. Regulatory compliance monitoring stations in Silver King Creek are inadequate. Thus, the true chemical concentrations along most of the extent of Silver King Creek and tributaries will be unmeasured, and compliance with the NPDES permit to "meet label requirements" will not be verified.

Rotenone from CFT Legumine apparently persists in streams, and rotenone is deposited in sediments where, according to McMillin and Finlayson (2008), it decomposes more slowly than in open water. As they pointed out for their lake samples "The most persistent constituent of the CFT Legumine™ in sediment was rotenone. Rotenone persisted in sediment for up to six months" (McMillin and Finlayson 2008, p. 20). But it must also be remembered that no measurements were made of the other active ingredients, unspecified "cube resins."

Their data for tributaries (Appendix I) also suggested persistence of rotenone in the streams. After 12-14 days the three tributary streams were poisoned a second time in 2007. Water samples from 10 locations on Big Grizzly Creek immediately <u>before</u> the second poisoning averaged 19.5 $\mu g/L$ rotenone and 59.8 $\mu g/L$ of rotenolone. Because no poison had been applied to the streams for 12 to 14 days, we assume that rotenone was slowly released from bottom sediments back into the water column and there is a behavior of CFT Legumine that is unexplained and unknown at present.

Finally, all the actual values from field samples in the Lake Davis project were higher (on average 16 % higher) than reported. This conclusion follows from the findings given by McMillin and Finlayson (2008) who reported results of laboratory testing of compound recovery of major constituents in CFT Legumine (Appendix A, Table 5). After fortification, they tested compound recovery at concentrations of 2, 10, 50, and 100 $\mu g/L$ rotenone. We found no difference ($p>0.05$, ANOVA) in the percentage recovery of rotenone at the four levels of Lake Davis water, and the average recovery from all tests combined was 83.9%. No samples equaled or exceeded 100% recovery. We have not adjusted the data, nor did McMillin and Finlayson (2008), for the three tributaries but the true concentrations of rotenone exceeded the target values that were reported.

New EPA Label Requirements

Poisoning of Lake Davis and its main tributaries took place in September 2007. On March 31, 2007 the US EPA released its Reregistration Eligibility Decision for Rotenone (RED for rotenone). That decision required changes to labels for all piscicidal uses of rotenone. Included in these changes were separate maximum treatment concentrations for lakes and streams (US EPA 2007):

Restrictions for all Formulations	"The Certified Applicator supervising the treatment must remain on-site for the duration of the application." "Do not allow recreational access (e.g., wading, swimming, boating, fishing) within the treatment area while rotenone is being applied." "In lakes/reservoirs/ponds, do not apply this product in a way that will result in treatment concentrations greater than 200 parts per billion." "In streams/rivers, do not apply this product in a way that will result in treatment concentrations greater than 50 parts per billion."

Although the poisoning of Lake Davis occurred in September after the release of the new label requirements in March, 2007, the CDFG apparently chose not to follow the new requirements. As McMillin and Finlayson (2008) noted in their report, the designed treatment concentrations for tributaries were 51 to 102 $\mu g/L$ of rotenone.

To summarize, the CDFG was unable to apply the rotenone in CFT Legumine at target levels. Levels were far above the target levels (> 1000% above target levels at some stations in the first poisoning), and high concentrations were even more common in the second poisoning than in the first (Fig. 1). These results indicate the inability of CDFG to deliver, under field conditions, the poison rotenone in CFT Legumine at designed concentrations. Based on the Lake Davis watershed results, we think it highly likely that the Agencies will exceed the EPA/FIFRA label requirement for normal use of 50μg/L in Silver King Creek if this project is allowed.

Rotenone persisted in the bottom sediments of Lake Davis for at least six months. Rotenone was measured in stream water 14 days after it had been applied. It had apparently persisted in bottom sediments and was being released back into the stream. These results indicate that CFT Legumine behaves in some unexplained and unknown ways. It is unknown if rotenone persisted in streams longer than this measured period. Monitoring was apparently not conducted beyond two weeks in streams.

The persistence of rotenone in stream sediments and ground water is a significant environmental concern that has not been analyzed in this EIS. Hyporheic invertebrate life will be affected by the residual rotenone in the substrate. Ground water should also be monitored. The Agencies are assuming that hyporheic invertebrates will re-populate streams that are poisoned (EIS/EIR p. 5.1-45; 5.1-19; Response to Comments, pp. F-50, F-80). They seem to assume that the rotenone in bottom sediments will not affect these invertebrates. (Incidentally, even assuming they would not also be poisoned, these would only be the hyporheic invertebrates in the upper part of stream bottom sediments. Invertebrates lower in the hyporheos are restricted to that habitat.) But the Agencies have not considered the effects of rotenone in the stream sediments and hyporheos in this EIS.

Once poison has been applied to water, monitoring of either the poison or the animal life, no matter how thorough, cannot change the impacts of the poison, of the mistakes that were made, of information that was not known, revealed, or understood, or of species that were lost.

Rotenone withdrawn for terrestrial use and banned for marine and estuarine use

The rotenone picture has changed significantly in the last few years. The EPA conducted a review of rotenone in 2006. Subsequently, the manufacturers of rotenone withdrew it for all terrestrial use (insect and/or invertebrate control) in the U.S., Canada, and the European Union. The Environmental Protection Agency (EPA) asked the companies that produce rotenone to submit evidence on the neurotoxic effects of rotenone on humans. The companies chose to withdraw from the market the products containing rotenone rather than supply the data. (EPA website: www.epa.gov/oppsrrd1/reregistration/rotenone Docket ID: EPA-HQ-OPP-2005-0494) Many studies over the past 10 years have shown a connection between rotenone and Parkinson's disease.

In 2009, the EPA banned rotenone for use in marine and estuarine habitats.

The only use of rotenone now is as a freshwater poison to kill unwanted fish. It is a non-specific poison that also kills aquatic insects, other aquatic invertebrates, and amphibians at the same time it kills fish. As a consequence, rotenone poisoning disrupts aquatic and terrestrial food webs for many years and affects many other species. These effects have been acknowledged by the EPA (see Erman and Erman 2009).

No need for the project

The Paiute cutthroat trout currently is stable or expanding in populations in 10 separate streams in 5 separate basins (U.S. Fish and Wildlife Service 2004). Either five or six separate populations of Paiute CT, isolated by barriers, exist in the Silver King basin alone. In arguing the need for this project, the EIS stated that additional habitat is needed in order to secure the Paiute cutthroat trout from stochastic events or invasion by non-native fish that may compete or interbreed with it.

The EIS presents findings that the project will improve the population of PCT by reducing threats from genetic bottlenecking, by connecting with other populations within the Silver King watershed and by the enhancement of genetic diversity of the Paiute cutthroat trout (p. 5.1-11). The proposed project will do little or nothing to remove genetic bottlenecks in the populations of Paiute CT.

There is no evidence presented in the Final EIS/EIR of any plan or analysis that shows how creating one more population of Paiute cutthroat trout will or can remove the existing genetic bottlenecks in the fish. These bottlenecked conditions and limited genetic diversity are already in place. This condition would be expected for a population founded on a small number of individuals and through subsequent bottlenecking created from random genetic drift and the significant selective pressure caused by the Agencies removing spotted fish and isolating transplants.

Cordes et al., 2004, who did recent genetic work on the Paiute CT, stated that genetic bottlenecking "has almost certainly been exacerbated by the repeated chemical treatment and restocking of virtually all of the extant populations" (p. 116, Cordes et al. 2004). Cordes et al. showed that in the 9 separate populations they genetically tested, all but two (Fly Valley Creek and Coyote Valley Creek) are significantly different genetically from each other. Some populations have alleles that others do not have, some populations are missing alleles that are found in most or all other populations, and nearly all populations have significantly different frequencies of alleles (Tables 3 and 4, Cordes et al. 2004, Ex. 5). Merely stocking one more population below Llewellyn Falls that is disconnected from all other extant populations (no upstream movement, limited downstream movement) has no prospect of reducing genetic bottlenecks or enhancing genetic diversity.

In the first genetic consultant's report to the Agencies in 2002 (Israel et al. 2002, p. 12), and in the subsequent publication (Cordes et al. 2004) the authors recommended "Additionally, the development of molecular markers that can distinguish between LCT and PCT would be important for determining their genetic relationship and investigating the possibility of introgressive hybridization between the two groups <u>prior to any restorations</u>" (Cordes et al. 2004, p. 116, emphasis ours).

Beginning at least as early as 1973, Paiute cutthroat trout were selectively removed from the population if they had any spots. "The more rigid selection criteria was the result of a decision to remove all fish with body spots from the main Silver King Creek above Llewellyn Falls" (Ryan and Nicola 1976, p. 36). The zero spot selection was also applied to Four Mile Canyon Creek, forgetting that "this was one of the originally transplanted pure populations and that an introgressed population had not yet had time to develop" (Ryan and Nicola 1976, p. 36). All tributaries and the main stem above the falls were "subjected to intensive electrofishing directed toward the removal of hybrid trout from the drainage" (Ryan and Nicola 1976, p. 39) through 1975. Beginning in 1975, the selection criterion was relaxed by only removing fish with more than 5 spots. In the first year of removing spotted Paiute trout, the Agencies eliminated more than 50% of the entire population by this process (Ryan and Nicola 1976, p. 39). Selective removal apparently continued up to the poisoning of 1991-1993 (Flint et al. 1998, p. 7). By the end of the second year of poisoning, all recovered fish were without spots except for one nine-spotted individual in Four Mile Canyon Creek eventually tested as "pure" (Flint et al. 1998, p. 22).

The same definition of non-pure Paiute cutthroat was applied to the North Fork Cottonwood Creek population (the first out-of-basin transplant) when hybrids were suspected, presumed pure fish removed, and the stream poisoned: "...fish with fewer than five spots were removed by electrofishing. These fish were then reintroduced back into the creek. The resulting population looked like pure Paiute cutthroat trout, but biochemical studies indicated that the population still included hybrids. The pretreatment electrofishing had apparently selected for the 'correct' phenotype even in hybrid fish" (Moyle 2002, p. 293).

Behnke (1992) explained the issue of using body spots in any interpretation of cutthroat identities: "...their reliability is undermined by a major, unresolved problem: the size, shape, and distribution of spots on trout (of any species) can markedly change with very slight overall genetic change in a population" (p. 92). This knowledge perhaps explains Behnke's (1992) somewhat wry observation "I have observed specimens of the remnant *henshawi* [Lahontan CT] population isolated in the upper-most headwaters of the East Carson River that have virtually no spots on the body. Such specimens would be classified *seleniris* [Paiute CT] if found in Silver King Creek" (p. 116). Of course, the remnant population of Lahontan cutthroat in the upper East Carson River is but one more disconnected sub-population, isolated by falls from interbreeding with any other unit of the sub-species, and probably founded, like all the rest, with small numbers of fish subject to rapid random genetic drift.

The identification of "pure" Paiute cutthroat trout has progressed from counting spots (Ryan and Nicola 1976), measuring meristic characters (Behnke and Zarn 1976), using allozyme genetic analysis (Busack and Gall 1981), applying nuclear microsatellite and single copy nuclear DNA markers (Cordes et al. 2004) and finally single nucleotide polymorphism markers (Finger et al. 2008). In all this time, there has been no way of making a clear distinction between the Paiute cutthroat and the Lahontan cutthroat trout. The Paiute cutthroat had no unique alleles among any of the 10 loci compared to Lahontan cutthroat (Nielsen and Sage 2002, p. 381), and differs mainly in having many fewer alleles at the same loci (Nielsen and Sage 2002. p. 381, Cordes et al. 2004, p. 107). This condition would be expected for a population founded on a small number of individuals and through subsequent bottlenecking created from random genetic drift and the significant selective pressure caused by the Agencies removing spotted fish and isolating transplants.

To date, there has been no attempt to examine whether the specimens of Paiute CT preserved in the California Academy of Sciences could be examined for comparison with existing populations in order to form a genetic baseline.

Restocking would come from Fly Valley Creek, Four Mile Canyon Creek, upper Silver King Creek and possibly Coyote Valley Creek (EIS/EIR p. 1-3, 2-1, 2-4) but only streams with pure populations within the watershed (EIS/EIR p. C-2). Ignoring the out-of-basin populations guarantees that some of the genetic variation, distinct alleles represented only in those populations, will not be included in the new location.

The Agencies claim that the total number of adult Paiute CT in the entire Silver King Creek basin is 1020 (Final EIS/EIR). Included in this count are the fish in Fly Valley, Four Mile, and Silver King creeks (790 adult fish) and a further 100 in Coyote Valley Creek. This total cannot all be used in stocking elsewhere, and whatever the number, they are to be distributed over 6 miles of Silver King Creek below Llewellyn Falls and 5 miles of tributary streams. The Final EIS/EIR states that 30 – 150 fish of three age classes, including 75% sub-adults, will be restocked from donor streams (Attachment A, p. 7 – 8). Therefore, the stage is set for stocking a small number of fish into the new habitat, and once again creating the conditions of accelerated random genetic drift and further bottlenecking—exactly the opposite of what the EIS has found as justifying the project. If higher numbers of PCT are stocked, the populations at donor sites are placed at risk of extinction or further loss in genetic diversity from random genetic drift.

No proof of a barrier falls at the bottom of Silver King Creek canyon

The Agencies have failed to make the measurements we recommended for proving or disproving that a barrier to fish migration exists under all flow conditions for all non-native fish (Erman and Erman 2009). Rainbow trout and Lahontan cutthroat trout migrate far upstream during spawning season during high water flows in the spring of the year. The assumed barriers in the Silver King Canyon have only been assessed by the Agencies during lowest water periods in late summer and fall. A photograph submitted in the EIS/EIR as proof of a 10-foot falls, under low flows, also shows a second passage around the falls that is step-like and may likely allow fish passage under high water conditions (Ex. 6). This "highest barrier" is described as a falls that "drops approximately 10 feet vertically on the left side [looking downstream] of the main boulder and cascades through a tightly spaced series of smaller drops around the right side of the boulder over a distance of 20 or 30 feet" (USDA Forest Service EA 2004, p. 76).

In discussing the many failures made by CDFG in efforts to re-stock golden trout in the Golden Trout Wilderness Area, Phil Pister, retired fish biologist with CDFG wrote: "CDFG had for many years planted catchable rainbow trout there to satisfy roadside anglers, under a naive assumption that insurmountable natural barriers would prevent them from reaching golden trout country. Completely insurmountable barriers are very rare within natural stream systems " (Pister 2008).

The Final EIS/EIR has included information on leaping distances of 14-inch rainbow trout to imply that no fish could get over the falls. But private fish hatcheries (Deinstadt et al. 2004), certified by CDFG, sell fish to Alpine County who then introduces fish into public waters of the East Fork Carson River (Peter Ottesen at www.recordnet.com). One of the strains of fish developed by one of these hatcheries, the "Alpers" rainbow trout, reaches sizes as large as 20 inches and includes genetic material from steelhead salmon (Press Interview with Tim Alpers, Daily News, Los Angeles, CA, Sept. 22, 2002; http://www.thefreelibrary.com/ALPERS' ALCHEMY FISH FARMER CLOSES IN ON DESIGNING NEAR-PERFECT TROUT...-a092172642); Wild trout up to 20 inches in length are now caught in the East Carson River (Ex. 7, Ecoangler.com).

If large fish can and have moved upstream into the Silver King Creek canyon in the past, then the reach now to be poisoned was the native habitat of the Lahontan CT, not the Paiute CT.

Fish Stocking by the Agencies in Silver King Creek and East Fork Carson River

Another reason for the project, stated in the EIS, is that the Agencies are concerned that non-native fish will be introduced by humans above Llewellyn Falls where the Paiute CT has been re-established. The same thing could happen with the new population of Paiute CT that the Agencies want to establish. The EIS was non-responsive in its answer to the EPA on the same point (p. F-135). And as discussed above, there are five separate populations of Paiute CT already in the basin.

The greatest threat of non-native introductions has come from the Agencies themselves. From 1930 through 1991 more than 200,000 fish representing six species, subspecies or hybrids have been introduced into the Silver King Creek basin on at least 92 separate occasions (EIS/EIR, Tables 5.1-2, 5.1-3). The most recent intentional introduction by the Agencies took place in 1991, the same year they began poisoning the upper Silver King Creek basin again. At that time fish were introduced into Tamarack Lake. The list above only includes recorded stocking events, but does not count what the Agencies call "inadvertent" introductions like the one that occurred in 1955 or 1956 when Lahontan CT were dropped by air into Whitecliff lake by a CDFG plane (Ryan and Nicola 1976). The authors speculated that the pilot could not tell the difference from the air between Whilecliff Lake and Tamarack Lake, the intended target.

At various times, fishing has been allowed and promoted in the Silver King Creek basin above the canyon. Most recently, the DFG requested and received permission from the Fish and Game Commission to increase the take limit from 5 to 10 fish in Silver King Creek to promote harvest.

In 2008, the CDFG invited selected individuals to accompany CDFG personnel on a private fishing trip to Silver King Creek to fish for Paiute CT in the closed reaches above Llewellyn Falls. (Ex. 8)

The DFG continues to advertise and promote the Heritage Trout Program that includes the Paiute CT in the list of species. (Ex. 8). The program leader of the Wild Trout Program and the Heritage Trout Program (David Lentz) is a co-author of the report (Deinstadt et al. 2004) that stated, "The planned addition of a catch-and-release Paiute cutthroat trout fishery below Llewellyn Falls, which is conditioned on removal of the existing trout population, will provide a unique opportunity." The Agencies have been promoting fishing for the new population of Paiute CT that they hope to establish with this poisoning.

It is not a requirement of the Endangered Species Act that a species must exist in high enough numbers to harvest in order to remove it from the list of threatened species. There is a major problem with the Agencies that want to establish a new sport fishery being the same as the Agencies that control the de-listing of the fish as "threatened."

Fishing is allowed and promoted in the wild trout reach of the East Carson River up to the Carson Falls (a Trialside Wild Trout Stream). Immediately above the falls, fishing is closed to protect an isolated population of Lahontan cutthroat trout. "This population is one of the few remaining composed of original Carson River strain fish" (Deinstadt et al. 2004, Ex. 9). Why do the Agencies see ill-intentioned anglers as an extreme threat in Silver King Creek, but not for a unique population segment of Lahontan CT? If the Paiute CT is as threatened and as rare as the Agencies claim, why have they not closed all the stream below Llewellyn Falls to fishing? And why are they promising a new fishery for Paiute CT and taking selected people into the closed area above Llewellyn Falls to fish?

The CDFG, in 1991, moved salvaged hybrid fish from Silver King Creek into reaches of the East Fork Carson River below Carson Falls near the Soda Springs Ranger Station (Ryan in Schaffer 1992, Ex 10) that have been designated Wild Trout waters since 1972 (no artificial stocking allowed) (Deinstadt et al. 2004).

<u>The Myth of the Historic range of Paiute CT</u>

The EIS justifies poisoning these streams with the claim that the areas to be poisoned are the historic range of the Paiute CT (Final EIS, p. F-3), but scientific evidence does not exist that Paiute CT is the native trout below Llewellyn Falls. The Agencies persist in creating the impression of data and science where there are none. They repeat citations in literature for the historic range of Paiute cutthroat below Llewellyn Falls:

> "The historical range has been documented in numerous scientific documents (Behnke and Zarn 1976, Ryan and Nicola 1976, Busack 1975, Behnke 1979, Behnke 1992, Moyle 2002). The original specimen (the "type specimen" or "holotype") of Paiute cutthroat trout was collected by Snyder (1933) outside of the historical range described above. Behnke (1992) clarifies the discrepancy between the collection location (type locality) and the historical range…" (FEIS, Master Response C, p. F-3).

All references trace back to the same, identical source: the letter from Connell, a sheep rancher, in 1944 to CDFG biologist Curtis (reproduced in Ryan and Nicola 1976). In that letter, Connell only claimed that he and his friend did not catch any fish above Llewellyn Falls. He also grossly exaggerated how many fish they caught in 2.5 days of fishing below the falls. Thus, a reasonable interpretation of his recollection 54 years after the events might just as well be that he did not catch <u>many</u> fish compared to the catch below the falls. He also, despite creative editorial interpretation by the FWS (2004) of "spotted fish," did not identify <u>any</u> fish from Silver King Creek. His only descriptive terms were "fish" and "mixed with different kinds" or "varieties." What species he saw anywhere remains a mystery. The Agencies know these facts. Just as they know that in Snyder's (1933) original description of the Paiute cutthroat he mistakenly claimed it was a spotless form of the Lahontan cutthroat (Ryan and Nicola 1976). It is shameful to perpetuate these claims. There is only one substantiated scientific finding for the "historic range" of the Paiute cutthroat—Snyder's (1933) original collection above Llewellyn Falls. The Revised Recovery Plan (FWS 2004) eventually acknowledged that the native habitat of the Paiute CT is a matter of conjecture (p. 15).

References to Connell's herder (Joe Juanseras) for transplants above the falls are even more bizarre: no one other than Connell ever spoke to Joe. Thus, Connell's account of transplants above the falls is second-hand information as well. But, when another report (Ashley 1970) claimed that Joe's brother, not Joe, reported that the original 1912 plant above the falls was a failure and success did not occur until 1924, the story is discounted "...we do not accept Ashley's statement that the original plant was a failure" (Ryan and Nicola 1976). These second-hand stories are not a scientific basis for establishing the true "historical range" of the Paiute cutthroat trout below Llewellyn Falls, no matter how many times or where they are repeated.

Conclusion

In conclusion, this is the same project that has been proposed twice before and the scientific reasons for it are no better than in the past. It will cause long-term impacts to non-target species, to aquatic macroinvertebrate communities, and to the food webs and species that depend on them for food. Further poisoning of Silver King Creek should be abandoned by the Agencies. If they want to establish a fishery for Paiute CT, they should remove unwanted fish mechanically over the next several years. Once poison has been applied to water, monitoring of either the poison or the animal life, no matter how thorough, cannot change the impacts of the poison, of the mistakes that were made, of information that was not known, revealed, or understood, or of species that were lost. Our Wilderness Areas were not meant to serve only a select group of species or people.

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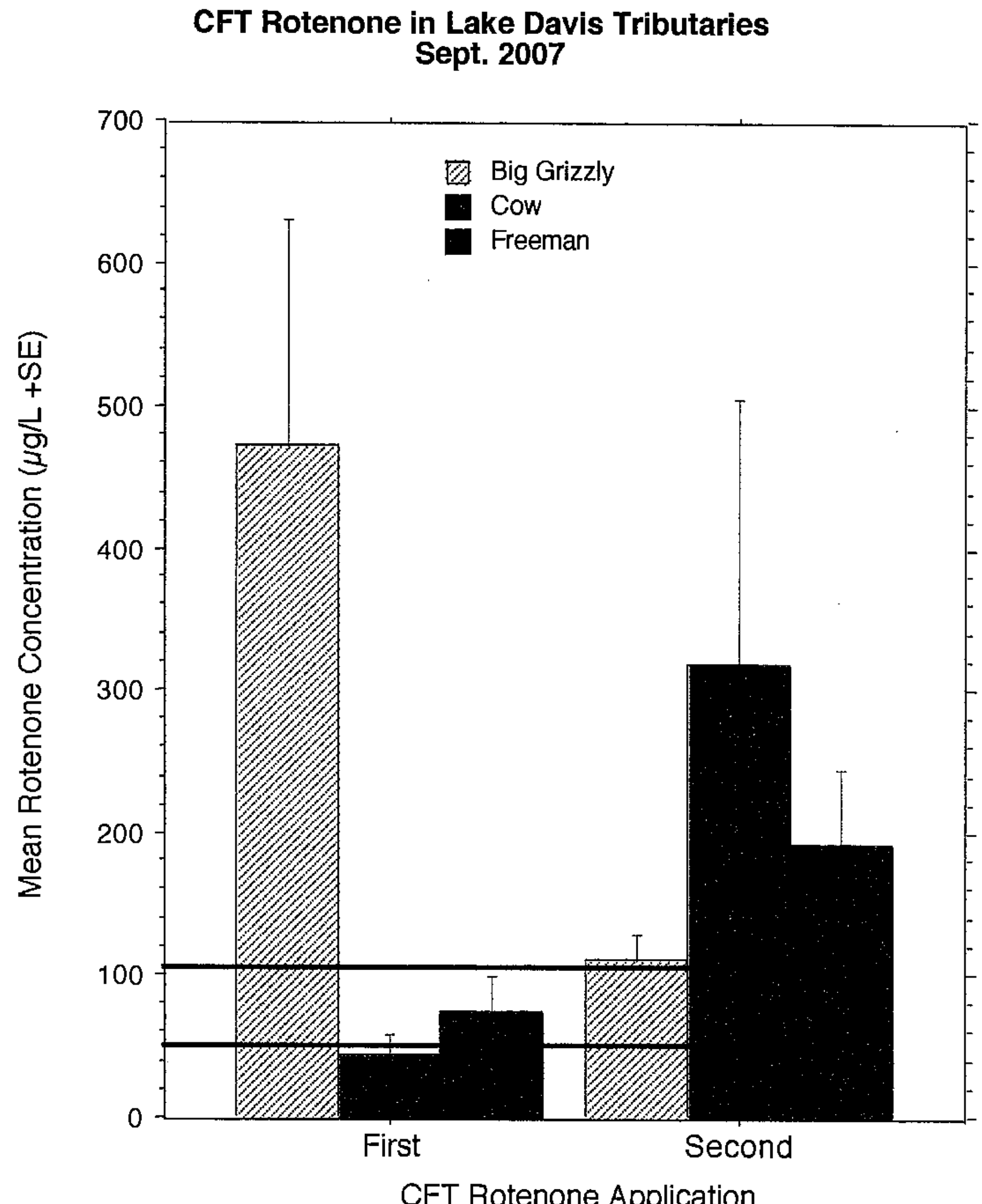

Fig. 1. Rotenone in Lake Davis tributaries, horizontal lines represent target concentrations.
(Data from McMillin and Finlayson 2008)

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Status of Aquatic Invertebrates

ABSTRACT

The aquatic invertebrate fauna of the Sierra Nevada is diverse and extensive, with many endemic species throughout the range. Aquatic systems differ widely in the Sierra because of such natural factors as elevation, climate patterns, geology, substrate type, water source, water volume, slope, exposure, and riparian vegetation. These differences are reflected in the aquatic invertebrate fauna. Small, isolated aquatic habitats such as springs, seeps, peatlands, and small permanent and temporary streams have a high probability of containing rare or endemic invertebrates. Aquatic invertebrates are a major source of food for birds, mammals, amphibians, reptiles, fish, and other invertebrates in both aquatic and terrestrial habitats. Changes in a food source of such importance as aquatic invertebrates can have repercussions in many parts of the food web. The life cycles of aquatic invertebrates are intricately connected to land as well as water, and the majority of aquatic invertebrates spend part of their life cycle in terrestrial habitats. Aquatic invertebrates are affected by human-caused activities on land as well as activities in the water. Land and water uses and impacts are reflected in species assemblages in streams and lakes. Changes in aquatic invertebrate assemblages have been used for many decades to monitor impacts on land and in water. However, the level of detail of most monitoring is not sufficient to track species losses in aquatic invertebrates. Aquatic invertebrates have not been inventoried or well-studied at the species level in most of the Sierra. Aquatic invertebrates are rarely considered or evaluated in environmental impact assessments in the Sierra. Major changes have occurred in aquatic and terrestrial habitats in the Sierra over the last 200 years: we must logically assume that corresponding changes have occurred in aquatic invertebrate assemblages.

INTRODUCTION

To assess the status of aquatic invertebrates in the Sierra Nevada, we must first consider the status of aquatic habitats. Aquatic invertebrates have complicated life cycles that are inextricably connected to both aquatic and terrestrial environments (Erman 1984b). The impacts of human use of land and water are reflected in species assemblages in streams and lakes. As Gregory and colleagues (1987) noted, "The landscapes and biotic communities of terrestrial and aquatic ecosystems are intricately linked, and effective management must acknowledge and incorporate such complexity." Changes in aquatic invertebrate assemblages are measurable and have been used as a monitoring tool for more than eighty years (e.g. Cairns and Pratt 1993); thus, we know that invertebrate assemblages change with habitat changes. Major changes have occurred in aquatic habitats in the Sierra Nevada over the last 200 years (Beesley 1996; Kattelmann 1996; Kondolf et al. 1996; Mount 1995). We must logically assume that, as land and water are altered in the Sierra Nevada, aquatic invertebrate assemblages are changing; populations (e.g., Taylor 1981) and perhaps species are being lost. But most of these changes are occurring at unknown and undocumented rates.

In California, we do not have inventory data on aquatic invertebrates from 200 years ago. But neither do we have adequate inventory data on aquatic invertebrates at present. We have surveys of specific invertebrate groups in a few geographic areas of the Sierra, but a surprisingly small amount of survey information at the species level exists. There are not adequate systematic invertebrate inventories or surveys for even the national parks (Stohlgren and Quinn 1992). On the other hand, the responses of aquatic invertebrate assemblages to land and water alterations are well-known and have

Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, *Assessments and scientific basis for management options.* Davis: University of California, Centers for Water and Wildland Resources, 1996.

EX 1

been studied for decades in many parts of the world and, to some extent, in California. Therefore, we can predict generally how invertebrate assemblages will change in response to such environmental impacts as logging, grazing, mining, water development, construction, human settlement, and the introduction of exotic species. Habitat loss and degradation and the spread of "exotic" (non-native or nonindigenous) species are the greatest threats to biodiversity in running-water systems (Allan and Flecker 1993; Wilcove and Bean 1994). The extent of change in California river systems has recently been documented (California State Lands Commission 1993; Mount 1995). California may be unsurpassed for the extensive geographic scale and short time scale on which these basic changes have occurred.

Questions about invertebrate status in Sierra Nevada aquatic habitats are as follows:

- Are species disappearing?
- Are species assemblages changing or becoming simplified in response to changes in habitats?
- What is causing these changes?
- What can be done to reverse these changes?

Perhaps a fifth question we should be asking is

- Why have aquatic invertebrates been so little studied and so little considered in management in the Sierra Nevada and in California, in general?

This assessment can only begin to answer these questions.

Many aquatic invertebrates have specific and narrow habitat requirements and are restricted, therefore, to places that vary little from year to year. Others are generalists and can survive over a wide range of habitat types (Thorp and Covich 1991). The differences between these two groups and all the gradations between them are crucial to our understanding of what has been happening to aquatic invertebrate species and assemblages of species in the Sierra Nevada over the past 200 years, especially since the gold rush, when major alterations of aquatic systems began in the Sierra.

A knowledge of aquatic invertebrates at the species level is essential to assessing the status of biodiversity in the Sierra. Monitoring of invertebrates at a higher taxonomic level (genus, family, order) can be useful in indicating changes in invertebrate assemblages in response to some impact if proper controls are established, but such monitoring usually cannot determine loss of species. The term "species" has the same meaning for aquatic invertebrates as it has for any other group of living things; aquatic invertebrate species are not interchangeable. Just as the common pigeon (rock dove; Columbidae: *Columba livia*) is not the same bird as the band-tailed pigeon (Columbidae: *Columba fasciata*), nor a white fir the same as a giant sequoia, neither is one species (or genus, family, or order) of aquatic invertebrate the same as another. Each species has different habitat requirements and different tolerances to environmental variables.

Endemic species of aquatic invertebrates in the Sierra Nevada (and in mountains in general) are often isolated at all elevations in small first- and second-order stream systems and can be limited in distribution to such habitats as springs, peatlands, and small headwater streams (Erman and Erman 1975; Hampton 1988; Stewart and Stark 1988; Erman and Erman 1990; Wiggins 1990; Erman and Nagano 1992; Hershler 1994). Some groups of aquatic invertebrates (e.g., some families of stoneflies, caddisflies, flatworms, and snails) exhibit high species endemism and great diversity in the Sierra Nevada.

Fish assemblages are not indicators or surrogates for aquatic invertebrate communities in much of the Sierra. Fish communities are not diverse in the Sierra; game fish have been introduced and moved throughout the range by humans, and some (e.g., rainbow, brown, and golden trout) are more tolerant of degraded habitats and/or a broad spectrum of conditions than are many invertebrate species and invertebrate assemblages. Historic distributions of fish were very different from current distributions, and much of the Sierra was originally fishless (see Knapp 1996; Moyle et al. 1996). Further, many small aquatic habitats rich in endemic invertebrates are lacking fish species.

Aquatic invertebrates are an important source of food for birds, mammals, amphibians, reptiles, fish, and other invertebrates. Changes in terrestrial and aquatic habitats lead to changes in invertebrate assemblages, which in turn increase, decrease, or change food supplies for other animals. As impacts occur in a stream, species (or taxa) richness (number of species) decreases but the population size of some species may increase. Further, large-sized species are usually replaced by small species (e.g., Wallace and Gurtz 1986). Conversely, when the stream condition improves, larger invertebrate species replace small species (Grubaugh and Wallace 1995). Such changes can have critical impacts on species that depend on invertebrates for a food supply.

Aquatic systems differ widely throughout the Sierra because of such natural factors as elevation, climate patterns, geology, substrate type, water source, water volume, slope, exposure, and riparian vegetation. For these reasons it is not possible to describe a typical Sierran stream, lake, spring, peatland, and so on, or a typical invertebrate assemblage. The natural variability among aquatic habitats must be understood when the effects on invertebrates of anthropogenic disturbance are studied.

The waters of the Sierra are the responsibility of many federal, state, and local agencies and are subject, through these agencies, to many laws and regulations. How these agencies work together and how they apply and enforce these laws determine the fate of the aquatic biota. Making connections among the aquatic biota, aquatic habitats, and institutional responsibility and performance is necessary to understand the present state of and future possibilities for Sierra waters.

PROCEDURES AND METHODS

To assess the extent of aquatic invertebrate work in the Sierra Nevada, we searched several standard library databases, using an extensive list of invertebrate names and aquatic habitat keywords. This method, while not complete, gave a reasonable indication of research on aquatic invertebrates over approximately the last twenty years (the general period covered by the databases). Key researchers were contacted to fill in some gaps in the list of studies. These contacts revealed that several papers had been missed in the databases, but also that the technique had given a fairly thorough indication of the topics being studied and of primary researchers or groups of researchers doing the work. For purposes of analysis, studies were grouped into a few general categories by geographical area or type of study. These groups were (1) taxonomic studies, (2) impact studies, (3) geographic surveys of certain taxonomic groups, (4) behavioral studies, (5) studies pf Mono Lake, (6) studies of Lake Tahoe, (7) other lake studies, and (8) studies on mosquitoes.

With such arbitrary groupings, there was much overlap. For example, many of the studies of Lake Tahoe could be considered impact studies or behavioral studies. But the groupings were made to provide an understanding of distinct aquatic systems or problems and to discover the studies' relevance (or lack of it) to the SNEP objective of assessing status. Much money has been spent on mosquito research and there were many papers on this group of organisms, but mosquitoes were not evaluated for this chapter. The reasons for this will be discussed later.

In addition to the general search of databases, we contacted agencies through a letter asking for information and made individual contacts with people known to have specific information on invertebrate work. This step revealed unpublished, nonrefereed reports and studies for which data sheets and notebooks, but no reports, existed.

A third step was to contact experts from North America known to be working on certain groups of invertebrates in an attempt to compile up-to-date species lists for the Sierra and to get some idea of the percentage of endemism among Sierra aquatic invertebrates. Most of these efforts are ongoing and incomplete. Recent published information for some groups (e.g., stoneflies, caddisflies, alderflies, dobsonflies, snails, and clams) was sufficient for estimates. Large gaps in our understanding and knowledge of aquatic invertebrates in California and in the Sierra are evident and will be discussed in a later section.

A fourth source of available information is museum collections. However, the short time allowed for this project did not permit us to explore these. Such collections as the California Academy of Sciences; the Bohart Entomology Museum at University of California, Davis; the Los Angeles County Museum; and the University of California, Berkeley, entomology museum have material from the Sierra, as do many other museums in North America (e.g., the Smithsonian and the Royal Ontario Museum in Toronto). Museum material is known and up-to-date for invertebrate groups being actively investigated by experts. But much other material has not been studied, and information is undoubtedly contained in these sources. To have meaning, this material requires examination by experts who are currently studying systematics in their respective fields. Taxonomy has changed rapidly and significantly in many invertebrate groups over the last twenty-five years. Hence, each specimen must be examined to determine its classification.

This chapter deals largely with aquatic macroinvertebrates (those that can be seen with the naked eye), not with the microinvertebrates (those that require a microscope to be seen). Such microinvertebrates as protozoans, tardigrades, and rotifers, for example, have not been assessed. The emphasis in this chapter is on running-water habitats. Some examples, however, are from standing-water habitats.

HISTORIC CONDITIONS AND AGENTS OF CHANGE

By describing conditions that existed in the Sierra Nevada prior to the immigration of Europeans and Asians, that is, conditions of 200 or 300 years ago, we can understand better what has happened to aquatic habitats and what the implications of those changes are for aquatic invertebrates. The numeric assessment of change to aquatic habitats (the numbers of dams, diversions, roads, grazing allotments, etc.) is described elsewhere (for example, see Kattelmann 1996, Menke et al. 1996, and Kondolf et al. 1996); therefore, this section gives a general description only, for the purpose of demonstrating habitat under which aquatic invertebrate species and species assemblages evolved in the Sierra Nevada over thousands of years and how that habitat has changed. It is not a complete listing of all of the changes and impacts that have occurred in Sierra aquatic invertebrate habitats.

Two hundred years ago Sierra Nevada streams were continuous running-water systems: there were no dams, reservoirs, water diversions, or interbasin transfers of water. There is no, or almost no, similarity between invertebrate species assemblages in running water and those in standing water. The major taxa of many invertebrate groups are found in both general habitat types, and in gradations between them, but the species that live in these two habitats are usually different. For example, true flies, in the order Diptera (a major insect taxon) are found in both reservoirs and in rapidly flowing water, but the species, and in many cases the genera and families, are different in the two habitat types. To continue this example, a family of true flies called the net-winged midges, Blephariceridae, is found exclusively in rushing mountain streams. It has suction-cup-like attachments on the underside of its larval body and lives only in the strongest currents. Widespread construction of dams throughout the mountainous areas of California has probably changed the distribution and possibly decreased the number of species of this family of flies.

In general, burrowing Chironomidae larvae (another type of midge fly in the order Diptera) and oligochaetes (aquatic segmented worms) predominate in habitats where sediments accumulate (Johnson et al. 1993), and their numbers rise where streams have been converted to reservoirs. Stoneflies (Plecoptera), found primarily in running water, are eliminated in reservoirs (Stewart and Stark 1988).

To illustrate the scope of change, figure 35.1 shows the locations of dams that are more than 7.6 m (25 ft) high or that have a capacity greater than 61,674 m3 (50 acre-ft). Smaller dams and water diversions exist on many other small Sierra Nevada streams but are not shown in this figure. Prior to the construction of reservoirs, natural hydrologic cycles existed on all streams and rivers. Water was high in the winter and spring and low in the summer and fall. Invertebrate life cycles evolved over thousands of years in response to such hydrologic cycles. Invertebrate biomass in the water was highest during the high water period and lowest in the summer and fall. Aquatic insects are the largest component of the aquatic invertebrate community, and most of them emerge as terrestrial adults in summer and fall in the Sierra Nevada, with fewer species emerging in spring and a small minority emerging in the winter (e.g., Erman 1989). Thus, invertebrate biomass is low when the water is low because many insects are in the terrestrial stage or are in the egg or small larval stage.

Invertebrates can accommodate the natural rise and fall of floodwater by moving up with the water and outside the stream banks, by burrowing into the substrate, or by taking refuge in root wads and debris along stream edges. They return to the stream channel as the water recedes. Natural floods perform the function of flushing sediment from the stream system, which, in turn, increases pore spaces within the stream-bottom substrate and provides surface area for invertebrates to inhabit.

The suddenly fluctuating water caused by some dams and water diversions has a different impact on invertebrate populations than does a natural flood. Invertebrates are stranded as water volume is lowered suddenly and stream channels dry up. Also, invertebrates drift downstream when water is rapidly lowered or raised (Minshall and Winger 1968; Bovee 1985). Year-round constant flow, a condition found in some artificially managed streams, is also abnormal to invertebrate communities of the Sierra Nevada. Under constant flow, sediment is not flushed from streams, and other poorly understood triggers to life cycle changes and in-stream migrations may not be present (Reiser et al. 1989).

Sediment from mining, logging, cattle grazing, roads, and construction had not entered Sierran streams 200 years ago. Natural sources of sediment, such as landslides from heavy rains and fires, were present, of course, prior to our recent history, as they are today. We can assume, therefore, that the quantity of sediment entering the aquatic systems of the Sierra today is far greater than it was. Much of this sediment is trapped behind dams at present (where it causes problems in water storage operations) (Kattelmann 1996) and is thereby removed from the stream system below dams. One example is the Mokelumne River watershed basin, where erosion rates estimated over the last twenty-five years are more than eight times higher than they were in 1944 (Robert C. Nuzum, Director of Natural Resources, East Bay Municipal Utility District, letter to Don C. Erman, September 25, 1995). The primary land use in the basin is timber harvesting (consisting of 98.5% of the land base).

The effects of sediment on aquatic macroinvertebrates have been amply demonstrated and known for many years (e. g., Cordone and Kelley 1961; Buscemi 1966; Chutter 1969; Brusven and Prather 1974; Luedtke et al. 1976; Waters 1995). In streams, sediment accumulation depletes available habitat for invertebrates, as pore spaces in the rocky substrate are filled with sand and silt. Over time, continued sedimentation can create a cemented stream bottom with no substrate pore spaces available for invertebrate colonization. Only a few highly tolerant invertebrate species will persist in these conditions. The gold mining areas contain examples of sediment accumulation that are even more dramatic. There, certain streams have become so filled with sediment that surface flow no longer exists. Where 200 years ago rocky-bottomed streams flowed, today sediment-filled, seasonally dry stream channels are evident many feet above the original channel (Mount 1995). A striking example of this impact is Shady Creek on Highway 49 near North Columbia. As sediment increases, species richness, density, and biomass decrease. Sediment obstructs respiration, interferes with feeding, causes loss of habitat and habitat stability, and may alter production of invertebrate food sources (Johnson et al. 1993).

In the past, streams were more shaded and were lower in temperature because there was more riparian cover. Headwater streams were deeper and narrower, in meadows and wetlands. They had rocky bottoms and were covered by either willows or alders, or by sedges and grasses. Today, small first- and second-order streams (small streams in the headwaters of river basins and also in river branches at all elevations of the Sierra) of this description are found largely in national parks. Livestock grazing has decreased or eliminated riparian vegetation, broken stream banks, widened stream bottoms, increased sediment, decreased shade, and increased water temperature (Platts 1978; California State Lands Commission 1993; Fleischner 1994; Li et al. 1994; Menke et al. 1996).

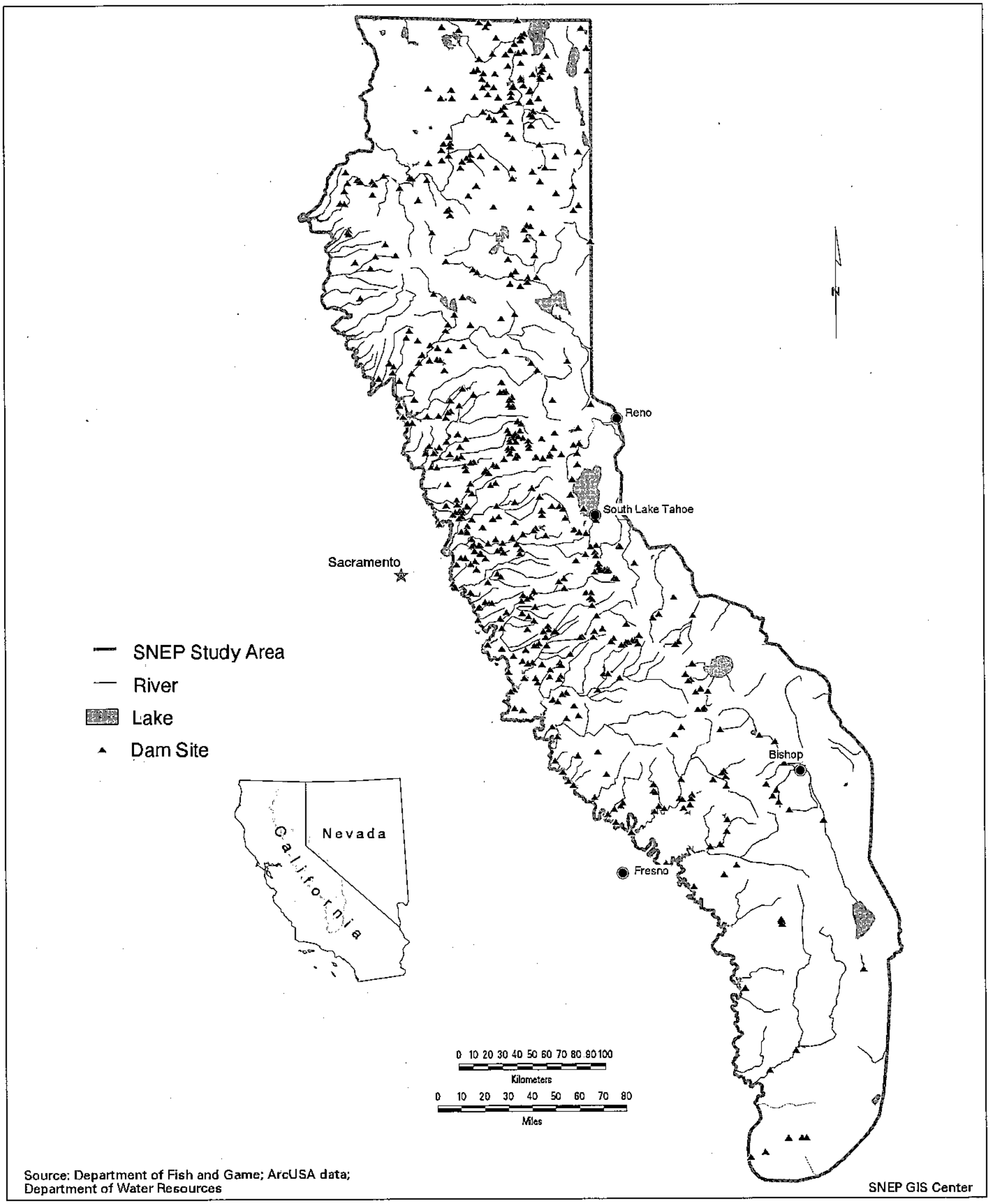

FIGURE 35.1

Dams in California that are at least 7.62 m (25 ft) high or that have a capacity greater than 61,674 m^3 (50 acre-ft) (from California State Lands Commission 1993).

Stream channels in the presettlement period meandered in areas of low gradient; they had not been straightened for logging, mining, or road building. Streams were not artificially confined to a channel. We can probably can assume that there was more wood in streams (Sedell and Luchessa 1982). Wood has been intentionally removed by state and federal agencies, including the California Conservation Corps, and by loggers and woodcutters. In addition, downed wood was retained more easily in meandering stream channels (Sedell and Maser 1994). Wood in streams serves several functions for invertebrates. It retains organic matter (leaves, sticks, and needles) that falls into the stream. It slows the water and creates pools, thereby allowing the opportunity for invertebrates to feed on organic matter, which increases the efficiency of nutrient use. Wood creates complexity of habitat by forming pools and breaking up otherwise long stream runs. And some invertebrates feed specifically on the wood or attach themselves to the wood and feed on the algae, microinvertebrates, and bacteria that grow on wood (Murphy and Meehan 1991).

Two hundred years ago, streams were not diverted from their channels into ditches or pipes. There had been no dynamiting of fish barriers, and so some stream sections had isolated populations of invertebrates. There was no heavy metal contamination of water from mining, no dredge mining in channels, no concrete, no modern building, no bridges, no riprapped banks.

Springs had intact riparian vegetation, untrampled by livestock and unlogged. Some springs must have been used by Native Americans, but they probably were not channeled. And they were not sprayed with herbicides or diverted, as they are today for a variety of reasons, some of which include game management (Bleich 1992). Nor had ground-water pumping dried springs (DeDecker 1992). The potential for loss of endemic aquatic invertebrate species from springs, due to present management and use, may be greater than from any other aquatic habitat and will be discussed later.

Fish assemblages were different in the past from those of today, and the reasons for this change have had significant implications for invertebrates. Fish had not been transported or introduced from Europe or put into high-mountain lakes (see Knapp 1996; Moyle et al. 1996). In addition, the introduction of fish into reservoirs has resulted in upstream as well as downstream changes in fish assemblages because fish move out of reservoirs (Erman 1973, 1986). Much of the upper Sierra was fishless 200 years ago (Moyle et al. 1996). The introduction of a top predator can cause many changes in invertebrate assemblages, as discussed in detail by Knapp (1996).

Intentionally introduced invertebrate species, not present 200 years ago, are also causing community changes in Sierra waters. Examples are the opossum shrimp, *Mysis relicta* (Richards et al. 1975, 1991) and the signal crayfish, *Pascifasticus leniusculus* (Flint and Goldman 1975; Elser et al. 1994). Other invertebrates likely have been introduced unintentionally with the introduction of fish and with transfers of water within and between basins.

Hundreds of miles of stream and many lakes had not been poisoned by rotenone or other piscicides 200 years ago. The scale of rotenone use in the Sierra was not determined for this chapter, but a few published examples give an indication of the extent of its use. Rotenone has been used by the California Department of Fish and Game (CDFG) in California "for more than 45 years" (CDFG 1994a, 1994b). "In the past we have routinely treated the streams in a drainage . . . before impoundment" (Hashagen 1975). In the Kern River, drainage piscicides (rotenone and antimycin) have been used several times since 1960. Present ongoing plans are to poison 37 miles of the South Fork Kern River and its tributaries between 1994 and 1996 (CDFG 1994c). Between 1952 and 1954 a total of 286 miles of stream in the Russian River drainage (the tributaries and most of the main river) were poisoned with rotenone (Johnson 1975). Though not in the Sierra, the Russian River example gives an idea of the scale of past rotenone use in California. Rotenone and antimycin reduce populations of many aquatic invertebrates when applied to a body of water (Cook and Moore 1969; Degan 1973; Stefferud 1977; Maslin et al. 1988). This fish-management technique likely has simplified invertebrate communities, especially where used repeatedly. Although Native Americans used fish poison in streams as a fishing technique, the scale was much smaller and was not extensive in the Sierra (Rostlund 1948).

Insecticides, herbicides, fertilizers, and fire retardants had not been used over large parts of the Sierra landscape 200 years ago. Their effect on aquatic invertebrates may be significant (Norris et al. 1991). The scale of use and impact is unknown.

Humans with modern conveniences had not moved into wildland areas in record numbers. Even such small inventions as electric blacklight (ultraviolet) bug zappers may have a local impact on aquatic insects. Ultraviolet lights are known insect attractants; high numbers of night-flying female caddisflies, many with egg masses attached, are attracted to them (N. A. Erman, unpublished data). Ironically, while attracting many insects, they have little, if any, effect on their target insect, the mosquito, because most female mosquitoes are not attracted to ultraviolet light, according to Turpin as quoted in Purdue University 1993.

Fire probably had no more impact on Sierra streams and riparian zones in the past than it has today, although because drought cycles play a role in fire frequency there may have been longer periods of more fire in the past (Stine 1996). The effects of fire on streams are local and individual. Examples can be seen in the Sierra today of places where fire has jumped over streams and riparian areas, whereas, in other places, fire has burned to the stream edge.

Droughts have been cyclical in the Sierra over thousands of years, and some were longer and more severe than our recent eight-year drought (Fritts and Gordon 1980; Erman and

Erman 1995; Stine 1996). Many springs and wetlands (meadows and fens or minerotrophic peatlands) must have dried out or disappeared during those periods. Evidence indicates that the past 100 years or so has been a period of high moisture (Stine 1996).

Flooding of stream channels, on the other hand, probably was not as severe 200 years ago as it is under our present land use. We can assume that with more vegetative cover and fewer perturbations on the land, especially those due to road systems (Kondolf et al. 1996), water soaked into the soil in greater amounts than it does today.

In summary, invertebrate assemblages in the past were probably richer and species diversity was probably higher; that is, there were more species and their relative abundances were more evenly distributed in many habitats than they are today. Many cumulative impacts are present in Sierra Nevada aquatic systems that were not present 200 years ago. These impacts have a combined and often synergistic effect on stream systems. It is reasonable to assume that some species have probably disappeared from small, unique, isolated habitats (spring systems, small upper watershed streams, peatlands, and perhaps, high-mountain lakes and ephemeral ponds) that have been substantially altered or eliminated.

CURRENT CONDITIONS

Aquatic Invertebrate Resource

Endemic or Unusual Species

Many endemic species of aquatic invertebrates, known nowhere else in the world, are present in the Sierra Nevada. A wealth of evolutionary, ecological, and biogeographical information is contained in Sierra aquatic invertebrates. Among the more notable examples is the stonefly *Capnia lacustra*, present only in Lake Tahoe (Jewett 1963), the only stonefly in the world known to be fully aquatic in the adult stage (Nelson and Baumann 1989). Another unusual stonefly, *Cosumnoperla hypocrena*, is known from one intermittent spring in the Cosumnes River Basin (Szczytko and Bottorff 1987). Extensive searching has failed to produce this species from any other site. Worldwide, few stoneflies are known from intermittent habitats. A caddisfly, *Desmona bethula*, has been studied in sites at about 1,970 m (6,500 ft) elevation, where it leaves the stream on warm summer nights as an aquatic larva to feed on terrestrial vegetation, a behavior undescribed in the world prior to its being studied in the Sierra (Erman 1981). This species, too, is known from a small number of Sierra Nevada sites. Another caddisfly, known only from small streams in the Sierra, the Siskiyous, and the Cascades, *Yphria californica*, is possibly the most primitive living species of the tube-case-making caddisflies in the world (Wiggins 1962; Anderson 1976). A species of brine shrimp, *Artemia monica*, is endemic to Mono Lake (Belk and Brtek 1995). In the Sierra Nevada the symbiotic relationship between the midge larva *Cricotopus* and the algae *Nostoc* was discovered (Brock 1960). Endemic species of flatworms (Kenk 1970, 1972; Kenk and Hampton 1982; Hampton 1988), of amphipods (Holsinger 1974), and of hydrobiid snails (Hershler and Pratt 1990; Hershler 1994) have all been found in the Sierra. These are but a few of many such examples.

The percentage of endemism in aquatic invertebrates in the Sierra is apparently much higher than in terrestrial invertebrates (Kimsey 1996; Shapiro 1996). The reason is the discrete and isolated nature of small aquatic habitats in mountainous areas. The pattern for endemic amphibians occurring in aquatic habitats is similar to that of endemic aquatic invertebrates (Jennings 1996).

Aquatic Invertebrates as a Food Source

While the foregoing examples are of unusual species that are of great evolutionary interest to scientists, they may not be understood by most people as being of value. We are rarely taught the connections between small, seemingly obscure species and the larger species with which we are all familiar (Kellert 1993). And yet, in the details of small, unknown animals lies the fate of the animal world (Wilson 1987).

For example, the brine shrimp and alkali fly of Mono Lake provide food for thousands of migrating waterfowl from North and South America (Vale 1980; Lenz et al. 1986). Decreasing fresh water and increasing salinity in Mono Lake led to decreases in the alkali fly *Ephydra hians* prior to restoration of inflows to the lake and was the subject of concern and study of this critical invertebrate species (Herbst 1990, 1992; Herbst and Bradley 1993).

In Lake Tahoe, introductions of exotic fishes and an exotic invertebrate, the opossum shrimp, *Mysis relicta*, have led to periodic decreases in and disappearances of native zooplankton, species of *Bosmina* and *Daphnia*, which in turn have caused food shortages for fish (e.g., Goldman et al. 1979; Morgan 1979, 1980; Morgan et al. 1978; Richards et al. 1975, 1991) and possibly have caused increases in algae and decreases in water clarity. This story continues and is not completely understood. Suffice it to say that Lake Tahoe is now far from being a natural biotic community, and poorly considered introductions of exotic species, both fish and invertebrates, have played a major role in some of the changes that have occurred in the lake.

Aquatic invertebrates, in general, provide food to a vast array of birds, reptiles, amphibians, mammals, fish, and other invertebrates. Aquatic insects live in an aquatic habitat for only part of their lives and are terrestrial during other life stages, where they live primarily in riparian areas (Erman 1984b). They are a food source in all life stages for invertebrate-feeding animals in aquatic and riparian areas. Adult insects constitute a substantial percentage of the arthropod biomass and numbers near streams (Jackson and Fisher 1986;

Jackson and Resh 1989). Their numbers decline but are still significant 150 m (492 ft) or more from streams (Jackson and Resh 1989). This contribution of aquatic insects to the total arthropod assemblage near water makes riparian areas rich in food. Any vertebrate that is found in wet areas in the Sierra and that is known to eat invertebrates is likely feeding on aquatic invertebrates at some time. Many of these interrelationships have not been studied and are unknown in their specific details (but see, for example, Busby and Sealy 1979) but nevertheless are understood generally (Zeiner et al. 1988, 1990a, 1990b). For example, many of the bat species present in the Sierra forage over water for insects (Ron Cole, University of California, Davis, Department of Wildlife, Fish, and Conservation Biology, communication with the author, 1995; Zeiner et al. 1996). The water shrew eats aquatic insects, as may other shrews found in riparian areas (such as the vagrant shrew and the dusky shrew). Some part of the diet of the western jumping mouse, confined to wet areas, is likely aquatic insects, as are portions of the diets of the river otter, gray and red fox, mink, raccoon, marten, and western spotted skunk (Zeiner et al. 1990b).

A large number of bird species are dependent on aquatic invertebrates, either during all life stages (e.g. the American dipper, pied-billed grebe, and eared grebe); or during critical stages of breeding or the early life of the young (e.g., the gadwall, wood duck, tundra swan, American wigeon, belted kingfisher, red-winged blackbird, and yellow-headed blackbird); or during parts of the year when other food is unavailable. The list of birds that feed on invertebrates in and over wetlands, lakes, or streams is extensive (e.g., the hooded merganser, common merganser, spotted sandpiper, Forster's tern, black tern, tree swallow, violet-green swallow, bank swallow, barn swallow, willow flycatcher, black phoebe, Swainson's thrush, and yellow warbler). The few examples given here show the diversity of bird life in the Sierra and the northeastern plateau of California that depends on this food source (Zeiner et al. 1990a).

Several threatened amphibian species in the Sierra are highly dependent on aquatic invertebrates during the adult stage of their lives; these include the red-legged frog, foothill yellow-legged frog, mountain yellow-legged frog, and spotted frog (not in the Sierra but in Modoc County). Further, locally distributed salamanders that are present in springs and seeps—the Inyo Mountains salamander, and Mount Lyell salamander—likely feed on aquatic invertebrates. Also, the long-toed salamander, rough-skinned newt, California newt, and Yosemite toad, and the western pond turtle, a reptile, are all known to eat aquatic invertebrates (Zeiner et al. 1988). But this list is far from complete, and interested readers are referred to the three-volume work California's Wildlife (Zeiner et al. 1988, 1990a, 1990b) for specific details and references on Sierran vertebrate species.

Of course, many fish also depend on aquatic invertebrates, as do all animals that feed on those fish (e.g., the great blue heron, belted kingfisher, bald eagle, marten, mink, and river otter).

When a food source of such importance and magnitude as aquatic invertebrates is changed or extinguished in an area, even temporarily, it can have repercussions in many parts of the food web.

State of Knowledge of Aquatic Invertebrates

California has never undertaken the task of systematically and thoroughly surveying the invertebrates of its aquatic habitats, and in this regard, we lag behind the eastern United States, Europe, and much of Canada. Lack of expertise in California universities and state and federal resource agencies is a reason for this paucity of inventory data on aquatic invertebrates (see also Kimsey 1996). A shortage of aquatic invertebrate taxonomists and systematists worldwide is an obstacle to developing an understanding of issues of changing biodiversity and the impacts of environmental degradation (Disney 1989; Ehrenfeld 1989; Wiggins 1990; Erman 1992a).

Obsolete taxonomic keys and species lists are a problem for students of California aquatic invertebrates. When, *Aquatic Insects of California* was first published by Usinger in 1956 (it was reissued in 1963 and 1968) (Usinger 1956), it was considered a landmark work for a state and continued to be praised years later (Hynes 1984). But even at the time it was published, it was written from somewhat idiosyncratic collections of insects, not from systematic inventories, in most cases. Although it included species known then in California, it was far from complete. For example, 47 additional species of stoneflies alone have been found in California since the Usinger book was first published. (At present 167 species of stoneflies are known for California [R. L. Bottorff, R. Baumann, B. P. Stark, and N. Erman, unpublished list]). In addition, revisions of systematics for nearly all groups in the book have made many changes in species names and evolutionary relationships. Further, insects, though they constitute the largest taxon of freshwater invertebrates (that is, the taxon containing the greatest number of species), are not the only invertebrates present in Sierra waters. Examples of other groups not included in the Usinger book are flatworms, nematodes, segmented worms, snails, clams, and crustaceans (fairy shrimp, crayfish, isopods, etc.).

Species Inventories and Endemism in the Sierra Nevada

We can ascertain the extent and nature of aquatic invertebrate diversity by examining taxa in a few geographic areas in the Sierra where extensive survey work has been conducted on some groups. This effort is woefully incomplete because we do not have a Sierra-wide inventory, but it is a beginning and indicates the percentage of endemism and numbers of species in some basins (table 35.1). Endemism in the context of

TABLE 35.1

Estimated number of species of selected aquatic invertebrate taxa in some areas of the Sierra Nevada (see text for references).

Taxon, by Area	Number of Species Present	Number of Species Endemic to Sierra	Percentage of Species Endemic to Sierra
Sagehen Creek Basin			
Stoneflies	38	6	16
Caddisflies	77	11	14
Mayflies	22	?	?
Cosumnes River Basin			
Stoneflies	79	16	20
Fresno, Kern, Madera, and Tulare Counties			
Caddisflies	128	11	9

this chapter means species that are found only in the Sierra Nevada. Many other species are present in the Sierra in only one or a few other places but are not strictly endemic.

Specific Studies by Location

Sagehen Creek Basin. One of the better-studied stream basins is the Sagehen Creek basin on the east side of the Sierra, north of Truckee, where the University of California has operated a field station in the Tahoe National Forest since 1951 (see also Kimsey 1996). Even here, however, some groups, namely stoneflies (Plecoptera) and caddisflies (Trichoptera), have been well surveyed, and others, for example, true flies (Diptera) and mayflies (Ephemeroptera), are still incompletely known. Stoneflies were comprehensively surveyed in 1967 (Sheldon and Jewett 1967), and the list was revised and updated for the first North American Plecoptera Conference in 1985 (R. Baumann, W. Shepard, B. Stark, and S. Szczytko, unpublished data, available from N. A. Erman). Thirty-eight species of stoneflies are known from the Sagehen Creek basin. Seventy-seven species of caddisflies have been found in the basin (Erman 1989). Twenty-two species of mayflies have been identified in the basin, but this collection has not been verified by experts on Ephemeroptera, and the actual number is probably higher (D. C. Erman and N. A. Erman, unpublished data). Aquatic habitats surveyed included Sagehen Creek (a second-order stream), springs, spring streams, temporary streams, temporary ponds, and peatlands.

For the two well-studied groups in this stream basin we have an estimate of endemism: 11 of the 77 species of caddisflies are probably endemic to the Sierra (14%), and 6 of the 38 stonefly species (16%) are endemic, based on present information.

Cosumnes River Basin. Another study of stoneflies was conducted on the west side of the Sierra throughout the Cosumnes River basin (Bottorff 1990) where seventy-nine species were found over six stream orders, from headwater streams to the major river at the lower part of the watershed (R. Bottorff, telephone conversation with the author, October 11, 1995). Sixteen of these species are endemic to the Sierra; seventeen are endemic to California. Some species endemic to the Sierra are also found in Nevada and are therefore not considered California endemics but are, nevertheless, Sierra endemics. Twenty-six of the species found in the Cosumnes River basin were also present in the Sagehen Creek basin, and four of these are Sierra endemics.

Fresno, Kern, Madera, and Tulare Counties. Extensive blacklight collections of caddisflies have been made in Fresno, Kern, Madera, and Tulare Counties, in the San Joaquin–Tulare basins, by D. Burdick and R. Gill (as reported in Brown 1993). Some species were collected by other methods. Species are reported by elevation from 30 m to 2,652 m (100 ft to 8,700 ft) above sea level. We eliminated species found only below 213 m (700 ft), synonymous species (species described more than once in the literature), and species listed as new species but for which no description exists in the literature. With these criteria, the number of caddisfly species reported by Burdick and Gill for these four Sierra Nevada counties was 128. Eleven of these species are endemic to the Sierra.

Black lights are known attractants of some insects and thus sample an unknown area. Some species are more attracted to them than are others, and day-flying species may not be collected with black lights. The results from blacklight collecting are difficult to interpret in terms of estimating the species richness of a given area or habitat. Therefore, this number is subject to revision, but it gives a general idea of west-side Sierra caddisfly species in these basins.

A comparison of this list with the east-side Sierra study of caddisflies in the Sagehen Creek basin (Erman 1989) shows that 50 species were collected in both areas and that 27 species were present in the Sagehen Creek basin that were not found in the San Joaquin–Tulare basins. Jaccard's index of similarity (Pielou 1984) showed a 32% similarity between the two areas.

With only these few comprehensive surveys and collections of Plecoptera and Trichoptera species in a given area of the Sierra, we can say little about relative diversity. Species-level surveys in other parts of the Sierra are greatly needed.

Selected Taxa of Invertebrates

A few taxa were selected for more in-depth analysis for this chapter to determine percentages of endemism in the greater SNEP study area. Taxa were selected because they have been studied recently, because databases existed and were being kept up-to-date by experts in that taxonomic group, or because a reasonably recent (since 1970) monograph had been published.

The difference between collections and surveys is important here. The total number of species for the state is based on collections. These usually consist of one-time visits to a site, with the collectors using one or two types of collecting methods. The numbers of species for the Sagehen Creek basin and the Cosumnes River basin, in the previous section, are based on surveys. A survey uses some kind of systematic sampling scheme. The sampling methods used by Sheldon and Jewett (1967), Bottorff (1990), and Erman (1989) were different, as would be expected when different groups of organisms are being sampled for different reasons, but all were year-round samplings of all habitat types. Surveys of species done in other parts of the Sierra would greatly enhance our knowledge of invertebrates and undoubtedly would reveal new species. Unless they are specifically designated as surveys, however, species numbers in this chapter are all based on collections (table 35.2).

Plecoptera (Stoneflies, Insecta). Plecoptera is one of the better known orders of freshwater invertebrates in California. It is also a small group (based on number of species) compared with the Trichoptera or Diptera. At present, 167 species are known in the state; 122 of these are present in the Sierra and 31 are endemic to the Sierra (R. L. Bottorff, R. Baumann, B. P. Stark, and N. A. Erman, unpublished list). The Sierra-Cascade system and the Appalachian system are considered the "two great centers of endemicity" for the North American Plecoptera. About 25 genera are thought to have evolved in each area (Stewart and Stark 1988). Most stoneflies are dependent on lotic habitats (running water) of high oxygen and low temperature, and so it is not surprising that their distribution would be concentrated in the Sierra.

Megaloptera (Alderflies and Dobsonflies, Insecta). Alderflies (Sialidae) are a small group of aquatic insects with only 24 North American species; 9 of these are present in the western United States (Whiting 1991a, 1991b, 1994). Six species are known from California, and one is endemic to California. Four species are present in the Sierra as well as in other parts of the state.

Eleven species of dobsonflies (Corydalidae) are known in California, and seven of these are in the Sierra (Usinger 1968; Flint 1965; Evans 1984). Sierran endemism of species in this family was not determined.

Trichoptera (Caddisflies, Insecta). The caddisflies are a large and diverse group of aquatic insects, and species are found in nearly all freshwater habitats. At present, 308 species are known in the state; 199 of these are present in the Sierra, and 37 are endemic to the Sierra (Morse 1993; J. C. Morse, personal database of published literature; N. A. Erman, personal database). The largest family of caddisflies in the state is Limnephilidae (63 species), and the second largest is Rhyacophilidae (59 species). These are also the largest and second-largest families in the Sierra. At lower elevations in warmer water, the family Hydroptilidae, the micro-caddisflies, is diverse and poorly known. New species of Trichoptera will be discovered with more extensive surveys.

Diptera (True Flies, Insecta). Diptera is the most diverse order of all freshwater invertebrates. Within the Diptera, the family Chironomidae (midges) is the largest (Allan and Flecker 1993). These taxa are some of the most difficult to identify and are greatly understudied in the Sierra. Many species of Diptera are semiaquatic and spend most of their lives in the riparian area at the land-water interface.

Two small and unusual families of Diptera are discussed here, but it should not be assumed that these in any way represent the vast spectrum and diversity of Sierra Nevada aquatic Diptera. A third family of Diptera, the mosquitoes (Culicidae), is briefly discussed.

Blephariceridae (Net-Winged Midges, Insecta: Diptera). As was mentioned earlier, a family of true flies called the net-winged midges, Blephariceridae, is found exclusively in rush-

TABLE 35.2

Species estimates of selected aquatic invertebrate taxa in California and the Sierra Nevada. (Includes greater SNEP study area. See text for sources.)

Taxon	Total in California	Total in Sierra	Number Endemic to Sierra	Percentage Endemic to Sierra
Stoneflies (Plecoptera)	167	122	31	25
Alderflies (Megaloptera: Sialidae)	6	4	0	0
Dobsonflies (Megaloptera: Corydalidae)	11	7	?	?
Caddisflies (Trichoptera)	308	199	37	19
Net-winged midges (Diptera: Blephariceridae)	16	11	1	9
Mountain midges (Diptera: Deuterophlebeiidae)	6	4	1	25
Snails, clams (Mollusca)	?	40	8	20
Fairy shrimp, brine shrimp (Anostraca)	23	10	1	10

ing mountain streams, primarily in the western United States. The larvae have suction-cup-like attachments on their abdominal segments. Sixteen species (in five genera) of these flies exist in California (to our present knowledge), more than in any other state (Hogue 1973, 1987). Seven are endemic to California. Eleven are present in the Sierra Nevada (including Modoc County). All sixteen are present primarily in the Sierra and/or Coast Ranges. One species, however, is known from only one area in the northeastern corner of California (and the northwestern corner of Nevada).

Deuterophlebiidae (Mountain Midges, Insecta: Diptera). Another family of Diptera, the Deuterophlebiidae, or mountain midges, lives in much the same habitat as the net-winged midges and is present in the western mountains of North America and in eastern and central Asia. The larvae have rings of hooks on the abdominal prolegs to attach to rocks in the strongest currents. Only six species have been described in North America; four are present in the Sierra, and one is endemic to the Sierra (Courtney 1990).

Culicidae (Mosquitoes, Insecta: Diptera). Mosquito research was not analyzed for this chapter and is mentioned here only because mosquitoes have probably been studied more than any other aquatic invertebrate in California. Much mosquito habitat in the Sierra is in tree holes in the lower elevations and in snowmelt pools at higher elevations. Mosquito researchers think that reservoirs have not had a significant impact on mosquito distribution (B. Eldridge, Entomology Department, University of California, Davis, telephone conversation with the author, 1994). Mosquitoes prefer shallow water, often with aquatic vegetation, which is not the general condition of reservoirs. But discussion of possible changes in mosquito distribution caused by reservoirs is speculative because studies on this issue were not found for the Sierra. It is known that in other parts of the world reservoirs have caused epidemics of invertebrate-borne diseases and the spread of invertebrates undesirable to humans (Petts 1989).

Mollusca (Snails, Clams). Our information about mollusks is incomplete, but what is known is instructive. In 1981, thirty-two species of mollusks were known from the Sierra and northeastern California (Taylor 1981). None were endemic to the Sierra, but several had only one to a few populations in California and those were in the Sierra or northeastern California. Some of these populations were known to be extinct.

In recent years several new species of snails have been described in the Sierra. Eight recently described species in the genus *Pyrgulopsis* are considered endemic to the greater SNEP study area and are present in springs (Hershler 1994, 1995). *Pyrgulopsis* is the second most diverse genus of freshwater snails. *Pyrgulopsis* are widespread in the United States, and their range extends into southern Canada and northern Mexico. Seventy-two species were known and considered valid as of 1995, and eight of those were found only in a few spring systems in the Sierra Nevada study area (Hershler 1994, 1995).

Future work on mollusks will likely reveal new species of aquatic snails in the Sierra as thorough and systematic surveys are conducted, particularly on the west side of the Sierra, and as "modern" taxonomic study is used (R. Hershler, letter to the author, March 16, 1995).

Anostraca (Fairy Shrimps and Brine Shrimps). At present there are twenty-three species (six genera) of Anostraca known in California (Belk and Brtek 1995; B. Helm, personal database and conversations with the author, November 1995, January 19, 1996). Ten species are in the greater SNEP study area. Of the nine species endemic to California, three are in the SNEP study area. One is *Artemia monica*, a brine shrimp endemic to Mono Lake.

Fairy shrimp are generally restricted to small, fishless ponds and especially to temporary systems (Dodson and Frey 1991). Habitats of species in the foothills are probably the most threatened. These are the areas under greatest pressure from human development (Duane 1996).

Unique, Small, and Unusual Aquatic Habitats

Permanent Habitats

Some Sierra Nevada habitats, such as springs, seeps, peatlands, and small first- and second-order streams, have such a high probability of containing rare and/or endemic invertebrates and have received so little attention and protection from resource agencies that they deserve special mention. These habitats are also most likely to contain imperiled amphibians, according to Jennings (1996). Spring streams are first-order streams (though the reverse is not necessarily true) and are often isolated in mountainous watersheds. Second-order streams (formed when two first-order streams join) can also be small and isolated in steep terrain. Both stream types are found at all elevations in the Sierra; thus they are not necessarily synonymous with headwater streams.

Springs, because of their near-constant temperatures, are refuges for species from previous climate regimes. Invertebrates of both warmer and colder periods are present in springs. Thus, species living in springs are often isolated populations, far out of their present geographic range, either at much higher or much lower elevations or latitudes. They may undergo further evolution in isolated habitats, leading to new species. The more stable and long-lasting the spring, the greater the species richness and the greater the likelihood of its containing endemic species (Erman and Erman 1995). Isolated upper watershed streams have a similar probability, as do peatlands connected to these systems. Many endemic and unusual species have been found in Sierra spring systems where such systems have been studied (Erman 1981, Erman 1984a; Erman and Erman 1990; Hampton 1988;

Hershler and Pratt 1990; Hershler 1994, 1995; Holsinger 1974; Kenk 1970; Szczytko and Bottorff 1987; Wiggins 1973; Wiggins and Erman 1987).

Important to the understanding and management of these systems is that they are different from one another and are in close contact with the surrounding land. In a study of fourteen springs within one second-order (upper watershed) stream basin we found a similarity of only 25% among caddisfly assemblages in the various springs (Erman and Erman 1990). The springs differed widely in species richness and species composition. Some endemic species were present in only one or a few springs. The management implications of these findings are that spring "types" cannot be identified and set aside to protect or preserve species. In other words, all Sierran springs need some protection or consideration in land management.

The greatest threat to spring species in the Sierra today is probably livestock grazing because it is so all-pervasive and invasive to small, wet areas (Erman, unpublished information, S. Mastrup, California Department of Fish and Game, telephone conversation with the author; D. Sada, private consultant, telephone conversation with the author). But logging, road building, water development, dynamiting, wildfire, and other impacts in the vicinity of springs can affect riparian vegetation, water volume, timing of flow, chemical concentrations, solar radiation, and temperature regimes, making springs and spring streams uninhabitable to species restricted to them (Erman and Erman 1990).

One of the more ironic uses of headwaters is a multiagency (California Department of Fish and Game, Nevada Department of Wildlife, U.S.Fish and Wildlife Service, Pacific Southwest Region of the U.S. Forest Service [USFS] and Intermountain Region of the USFS) plan for spring streams to serve as safe holding areas for endangered fish. Headwater areas are poisoned prior to becoming repositories for fish that, in some cases, were not historically present (Gerstung 1986). Threats to unusual and endemic invertebrates under such a fish management scheme are apparent. This plan is an example of the fallacy of single-species management.

Temporary Habitats

Temporary aquatic habitats have been largely unprotected in management plans. While not rare in the Sierra, these habitats can have unique assemblages of invertebrate species. Temporary streams, ponds, and springs are not always recognized as aquatic habitats during dry seasons or periods, another reason they may be overlooked. Invertebrates that use temporary habitats have been studied somewhat in the Sierra (Abell 1957; Erman 1987, 1989; Szczytko and Bottorff 1987) and in western Oregon (Anderson and Dieterich 1992; Dieterich and Anderson 1995). Some species are confined to temporary habitats and require a drying phase to complete their life cycles. Such invertebrates are often widespread because of dispersal mechanisms evolved in response to variable habitats but not always (e.g., Szczytko and Bottorff 1987).

In addition to their importance for unusual invertebrates, temporary habitats can be areas of high invertebrate biomass and important spawning areas for fish. In the Sagehen Creek basin (on the east side of the Sierra), an intermittent stream that dries completely in most summers is the spawning ground for one-third to one-half of the rainbow trout population of the stream system (Erman and Hawthorne 1976). During the dry season, this streambed is grass covered and unrecognizable as an aquatic habitat.

The greatest threats to temporary aquatic habitats at present are logging operations and roads. These habitats should be treated as if they were permanent in terms of management protection: they are the habitat for species restricted to temporary water. Furthermore, intermittent or ephemeral streams connected to a permanent stream system are just as capable of transporting sediment downstream into larger streams as are permanent streams.

Aquatic Invertebrates as Monitoring Tools and Habitat Indicators

Values of Broad Taxa Invertebrate Monitoring

Invertebrates have been used as monitoring tools to assess water conditions for more than eighty years. Much of our knowledge about aquatic invertebrates in the Sierra and in California has come from this use. When using invertebrates as indicators of aquatic conditions, ecologists study a large assemblage of species at a site but identify and group species only at a broader taxonomic level (genus, family, order, or class). As water conditions change, some groups rise in numbers, others fall, and some may disappear or appear. As was discussed earlier, detrimental change due to some impact is usually in the direction of a decrease in organism size and a decrease in taxa richness (higher numbers of small species, fewer large-sized species, and perhaps fewer species overall, depending on the degree of impact [Wallace and Gurtz 1986; Grubaugh and Wallace 1995]).

One continuing, long-term study of logging impacts on invertebrate assemblages has been conducted in California since 1973 (Erman et al. 1977; Newbold 1977; Roby et al. 1977, 1978; Newbold et al. 1980; Erman and Mahoney 1983; Mahoney 1984; Mahoney and Erman 1984a, 1984b; O'Connor 1986; Fong, 1991). This study was conducted on 62 stream sites initially; 22 were in the Sierra Nevada. Logged and control (reference) streams were blocked into groups of three or four by geographical location, stream size, vegetation, stream morphology, and geology. Aquatic invertebrate assemblages were used to determine the effects of logging on streams and the effectiveness of wide and narrow buffered areas in protecting streams. The measurements used were diversity indices that examined invertebrate taxa richness and evenness of numbers within taxa. The study has been continued for two decades to assess stream recovery.

Major findings of the study were that the numbers of midge larvae (Chironomidae), the small mayfly *Baetis* spp., and small nemourid stoneflies rose significantly following logging in streamside zones without buffer strips, a result of increased sediments, increased light from loss of riparian vegetation, and increased algal growth (Erman et al. 1977).

Discrete, local disturbance from failed road crossings associated with logging caused a decline in the number of taxa downstream. Where wide buffer areas (strips) were left unlogged along the streams, invertebrate communities showed little difference from those of unlogged streams. However, narrow buffers incompletely protected streams, and the narrower the buffer, the greater the impact of logging on stream invertebrate communities. High levels of stored sediment remained in the set of streams logged without buffers when the streams were resampled five to six years later and compared to control streams. Full recovery of invertebrate communities required nearly twenty years after the initial disturbance from logging. A significant footnote to these long-term studies is that the control streams gradually were lost as controls because of further logging in the watersheds. New controls for research were established where possible.

Other impact studies in the Sierra that have used aquatic invertebrates cover a broad spectrum of subjects. A few examples are (1) the potential effects of copper in water (Leland et al. 1989); (2) the potential effects of acid deposition (Jenkins et al. 1994) (note that increased acidity in Sierra waters is not currently considered a problem according to Cahill and colleagues (1996); (3) the effects of suction dredge gold mining (Harvey 1982; Somer and Hasler 1992); (4) the effects of channelization (Moyle 1976); (5) the effects of fish introductions (Reimers 1979); (6) the effects of visitor use on high-mountain lakes (Taylor and Erman 1980); and (7) the effects of wildfire (Roby and Azuma 1995).

Limitations and Cautions of Broad Taxa Invertebrate Monitoring

A great deal of time, effort, and money have been spent on sampling and analyzing invertebrates from stream-bottom substrates in the Sierra Nevada. Much of this work has been conducted or funded by state and federal resource agencies (the U.S. Forest Service, California State Fish and Game, Bureau of Land Management, etc.). Most if it is in unpublished reports in agency files. Examples of such studies have been examined for this report. Problems of incomplete understanding of invertebrate sampling and what it can currently tell us in California are evident in the conclusions drawn from some of these efforts. Nevertheless, such sampling, if conducted with care and adequate controls, can serve as baseline work for future studies and should not be abandoned but rather expanded and conducted at more sophisticated levels in the Sierra.

In California several entities (e.g., timber companies, state agencies, citizen groups) are beginning programs in invertebrate monitoring to assess watershed condition. Therefore, a few points seem worth reviewing in regard to future studies in the Sierra Nevada and what such studies can reveal.

The natural variability of invertebrate assemblages in streams is poorly known in the Sierra. One-time or one-season invertebrate sampling cannot reveal the "health" of a stream or the extent of cumulative impacts in a stream basin at present. Changes over time in taxa richness and other various indices can show the direction of effect (i. e., are conditions worsening or improving?). Invertebrate sampling is a useful tool in stream monitoring if controls (references) in time and/or space (depending on the objectives of the study) are established, and if the limitations of stream-bottom substrate sampling are understood. Many papers and several books have been written on this subject (e.g., Plafkin, et al. 1989; Rosenberg and Resh 1993; Loeb and Spacie 1994), and a complete airing of the issues is beyond the scope of this chapter.

Stream-bottom samples, for the most part, cannot tell us what species are in streams. Species can be determined only from sexually mature forms for most aquatic invertebrates. The large majority of aquatic invertebrates (both biomass and species) in Sierran streams are insects, and the sexually mature form of most aquatic insects is the flying terrestrial adult. These adults are not collected in stream-bottom samples. Furthermore, the large majority of species descriptions for aquatic insects are based on males only, and so male adults are needed to determine species (Wiggins 1990).

Species identification becomes critical when invertebrates are being sampled to determine if a project or if cumulative impacts from many uses are having a permanent effect on species composition. The current interest in biodiversity and curbing the loss of species demands more rigorous analysis of invertebrates than is presently being conducted by resource agencies, universities, and consultants in California.

Recent examples of unproven conclusions based on invertebrate sampling are found in state documents for the continued use of rotenone in streams (CDFG 1994a, 1994b, 1994c). These documents and their use of supporting studies reveal a confusion between species and overall aquatic invertebrate assemblages. Invertebrate studies cited in the first two documents (1994a, 1994b) monitored not changes in numbers of species but rather changes in the numbers of larger taxonomic categories (e.g., order, family, or genus) of invertebrates. And the following statement is made in the Kern River negative declaration (CDFG 1994c): "Aquatic invertebrate populations will become reestablished in a few months. The species composition may be different initially and may require several years to return to the pre-project status." However, pre-project species composition was not determined for invertebrates. (It is not possible for species to "return to the pre-project status" if they have become extinct, and with the study that was conducted, we have no way of determining that.) These comments are not meant as a criticism of the original studies, but rather are meant to serve as a cautionary note about drawing conclusions that were not tested and then applying those conclusions to management policies.

Sampling must be appropriate for the question being asked. Many studies use sampling and analysis techniques merely because they provide numbers, with little regard for what is being sampled. An example is the use of invertebrate drift sampling as a general monitoring method in streams, without an understanding of the many natural causes of invertebrate drift. Another example is the rather arbitrary assignment of taxa (usually genus or family) to a functional feeding group. (Functional feeding groups are broad categories based on how invertebrates feed and can indicate broad trends in energy inputs to a stream system.) But what such categories indicate about stream conditions is questionable in the Sierra without controls and baseline data. A second problem with functional feeding groups in California is that they are based on general and incompletely researched tables from textbooks (e.g., Merritt and Cummins 1984) rather than on actual food-habit studies of the species (usually unknown) in question. Functional feeding groups may vary among species within a genus (that is, different species within a genus may feed in different ways) and with larval instar (stage) (Thorp and Covich 1991).

An example, for purposes of illustration, is the genus, *Dicosmoecus*, perhaps the most studied caddisfly genus in the western United States probably because of the large size of the individuals. Three species of the genus are present in the Sierra, sometimes in the same stream system (Erman 1989), but they live in different habitats. *Dicosmoecus gilvipes* feeds predominantly on diatoms and fine particulate organic matter by scraping substrate material. *D. atripes* and *D. pallicornis* feed largely on vascular plants and animal materials and are considered generalized predator-shredders (Wiggins and Richardson 1982). *D. gilvipes* is tolerant of warm temperatures, unshaded streams, and sedimentation. The other two species are present in cooler, shaded, undisturbed areas. The larvae of the three species are difficult to separate and are probably often confused. Conclusions about habitats or impacts based on larval identification or presumed functional feeding group could be quite misleading in this case.

A second example is of two caddisfly species with overlapping distributions in small Sierran streams, *Farula praelonga* and *Neothremma genella* (Trichoptera:Uenoidae). These two species, though in different genera, are difficult to separate as larvae except where they have already been studied (Wiggins and Erman 1987). *F. praelonga* reaches larval maturity in the winter and emerges as an adult in early spring, while *N. genella* matures through the summer and emerges in the autumn. Both feed by scraping diatoms from rocks. *F. praelonga*, the more rare of the two species, is most abundant in shaded areas with constant temperatures near spring stream sources, whereas *N. genella* reaches larger population numbers somewhat farther downstream from the source and in more open areas (Erman and Mahoney 1983; Wiggins and Erman 1987). Therefore, these two species, though in the same functional feeding group, would be affected differently by land management that, for example, opened the riparian canopy or changed water temperature.

Correct identification even of genera or families of invertebrates requires expertise, a knowledge of invertebrates, good up-to-date taxonomic keys, and knowledge of how to use the keys. Reference collections (sometimes called voucher specimens) are necessary to confirm identities of invertebrates from past studies. Taxonomy changes as groups of organisms are revised by experts. Without preserved specimens, studies from ten or twenty years ago become questionable, and there is no way to verify whether or not the taxa were correctly identified initially. These taxonomic changes or misidentifications probably would not affect the results of impact studies but would affect our knowledge of changes in species diversity, that is, of whether a species has disappeared over time.

Many habitat factors affect natural variability. Invertebrate assemblages can change rapidly over rather short distances if there are changes in light, temperature, substrate, water chemistry, elevation, and so on. An example from a study of Sierran spring streams illustrates this point. In one undisturbed spring stream, caddisfly (Trichoptera) species similarity between the spring source and a point 270 m (886 ft) downstream was only 38% (using Jaccard's index of similarity [Pielou 1984]). At 450 m (1,476 ft) downstream, species similarity with the spring source dropped to 20%. In another nearby spring with more water, less light, and lower temperature, caddisfly species were replaced less rapidly: similarity was 40% at 1000 m (0.6 mi) downstream and fell to 22% at 1,800 m (1.1 mi) downstream. Results were based on adult emergence traps, operated for a year on the first spring stream and for nineteen weeks through summer and autumn on the second spring stream. These two springs are near each other (about 1,600 m [1 mi] apart) in the same second-order stream basin and emerge from the same hillside, and yet the species similarity between the two spring systems was only 28% (Erman 1992b). Both were relatively protected from anthropogenic influence and had been for many years prior to the study.

This example may be somewhat dramatic because of rapid physical changes in small stream systems, but it nevertheless illustrates natural species replacement over a stream gradient and natural differences among nearby small, upper watershed streams.

If natural variation over a sampling gradient is not determined or accounted for, it can result in a study either underestimating or overestimating impacts to the invertebrate assemblage. Habitats already undergoing significant impacts may be selected as controls (references) and, thereby, underestimate the effects of some activity or project on the aquatic biota. Or, conversely, habitats naturally low in species (snowmelt streams, variable springs) may be considered degraded when they are not.

A recent survey of thirty-one Sierra Nevada streams from the north to the south Sierra was unable to detect the effect of cumulative impacts on invertebrate assemblages (based on one-time sampling at all but two sites), because natural variation over so broad an environmental gradient masked the effects within stream basins (Hawkins et al. 1994). An earlier study (Erman et al. 1977; Newbold 1977) had also concluded that natural variation rather than logging or disturbance effects accounted for variation in invertebrate assemblages when data were analyzed using multivariate analysis. However, in the earlier study, the effects of logging and buffer strips were clearly evident when streams were grouped by treatments and controls in the same geographic area. Further analysis of the Hawkins team's work must wait until the invertebrate data are published.

In conclusion, many levels of aquatic invertebrate monitoring are available for assessing environmental changes. The impacts on invertebrate assemblages of many land and water uses are known, and major changes have likely occurred in invertebrate assemblages in Sierra waters. But at present, we have little baseline information in the Sierra to know whether aquatic invertebrate species are being lost.

General Status of Aquatic Habitats

Currently, aquatic habitats are the most altered and threatened biotic communities in the state (Jensen et al. 1990). Recent forest plans contain reviews of conditions in the national forests. A few summaries are given here as examples of conditions, but no attempt has been made to review the aquatic analysis of all the forest plans. The plan for the Plumas National Forest (USFS 1988) found that one-third of the running-water fish habitat in the forest was in poor condition, 78% of it in small streams. Nearly half, 47.6%, of the small stream acreage was in poor condition. Only 20% of all running-water fish habitat in the Plumas National Forest was in good condition, according to the Forest Service's own assessment.

In the plan for the Stanislaus National Forest (USFS 1992) only two of sixteen watersheds were in very good condition. "Fair" and "poor" watersheds were lumped together, perhaps suggesting that there were more poor than fair watersheds. Analysis of aquatic habitat was less thorough in the Stanislaus plan than in the Plumas plan. Water projects were omitted from the discussion of cumulative watershed effects. Impacts of livestock grazing on streams were not analyzed in the plan, although 82% of the forest was grazed.

In the Modoc National Forest, 78% of riparian areas were in fair or poor condition in 1988 (U.S. General Accounting Office 1988).

The focus of resource management on game fish production poses a significant conflict with invertebrate diversity in Sierra waters (see also Knapp 1996; Moyle et al. 1996). Environmental assessments for projects of many types (e.g., hydroelectric projects, rotenone projects, proposed timber harvest operations, hydraulic mining regulations, Board of Forestry rules) have been reviewed for this chapter. None have contained adequate or realistic assessments of impacts to aquatic invertebrate communities; in most, there were no assessments. Projects are analyzed based on whether or not game fish (usually brown or rainbow trout) will be affected. Money and resources are directed toward that analysis objective. Little effort is made by state and federal agencies to protect species of no known economic value or species with few human defenders. More significant, however, is the apparent lack of understanding of the complex physical, chemical, and ecological processes and cycles that interact to determine the fate of biotic communities in Sierra aquatic habitats.

These assessments are not encouraging with regard to present trends in Sierra Nevada aquatic environments, but by admitting the problems and analyzing how they occurred, we can move on to restore degraded habitats and prevent the same problems in the habitats that are still in good condition.

Institutional Responsibilities

An assessment of aquatic habitats in the Sierra must include an assessment of the institutional management of those habitats. Many state and federal agencies have jurisdiction over the streams and wetlands of the Sierra, whether the land is privately or publicly owned. Such agencies as the California State Water Resources Control Board (the state water board) and its regional water quality boards, the Water Resources Agency, the California Department of Forestry, the Board of Forestry, the California Department of Fish and Game, Caltrans, the Fish and Wildlife Service, the Federal Energy Regulatory Commission, the U.S. Forest Service, the Bureau of Land Management, the Bureau of Reclamation, the Army Corps of Engineers, and many local county and city planning agencies all have authority and responsibility, regulations and laws governing Sierra waters and riparian areas. Evaluating the performance and effectiveness of these agencies is essential to improved watershed protection. How well are our present extensive regulations and laws working? How well are they obeyed and enforced? Do agencies communicate with one another and coordinate their efforts? Are agency decisions based on current scientific knowledge? Is continuing education encouraged within the agency? Do agencies recognize and admit resource problems and have the will to change? Do agencies evaluate their own past performance and effectiveness? How do they view the California Environmental Quality Act and the National Environmental Policies Act? Are agencies following the spirit as well as the letter of the law? Do they make decisions in an open and democratic manner? Do they welcome public input?

The answers to these questions are connected to and are crucial to the present and future status of the biota in Sierra waters.

FUTURE NEEDS

Future needs for the study and protection of aquatic and riparian habitats and, by implication, the status of aquatic invertebrates in the Sierra are in the areas of research, management, and institutional evaluation. The following recommendations are derived largely from the issues discussed earlier in the chapter.

Establish Reference Streams and Baseline Data

Aquatic habitat research for the Sierra should include the establishment of undisturbed reference streams and other aquatic sites to be monitored over time (controls). Streams in national parks may be the only reference sites remaining in the Sierra that are close to "natural" or undisturbed conditions, but they do not represent the full range of vegetation, elevation, and other Sierra Nevada stream conditions. We need to establish control sites in many parts of the Sierra, and this goal will require cooperation among many agencies.

We need complete aquatic invertebrate inventories and surveys, especially in undisturbed (or nearly undisturbed) sites to compare with disturbed (managed?) areas. University field stations could contribute substantially to this effort if they would make the commitment to undertake surveys at the species level. Few Sierra field stations have attempted to inventory aquatic invertebrate species. Where inventories have been conducted, they have been the specific interest of individual researchers and not a concerted university field station effort.

Improve Monitoring

Monitoring of stream invertebrates could be conducted at a more knowledgeable and meaningful level. Sampling to determine species and verification by taxonomic experts could make a significant contribution to our baseline knowledge of freshwater invertebrate diversity in California. Studies must be reproducible for long-term biomonitoring. We may not have the institutional organization in California at present to accomplish this level of research. California needs a natural history survey modeled after those of some eastern states (i.e., the Illinois Natural History Survey, and the Ohio Biological Survey). In some states these organizations are supported by private funding. An expanded role for the California Academy of Sciences could be explored in this regard.

Consider All Biota and All Impacts

We need better, more credible analysis of impacts to the entire biota. There are dangers in single species or even single-taxon management. There are also dangers in single-project review. The impacts of small hydroelectric projects or rotenone poisoning or grazing allotments or logging operations must be assessed in their entirety throughout the Sierra and for their cumulative and interactive impacts with one another. We need waterscape as well as landscape analysis.

Mechanical, species-specific means of removing unwanted exotic species should be encouraged. Chemical and mechanical methods that indiscriminately kill many species should be discouraged.

Value Citizen Groups

Citizens groups interested in watershed monitoring could be (and are) involved in identifying cumulative impacts; resource agencies should welcome this enormous source of energy and local expertise.

Recognize Problems with Reserves

We probably cannot protect aquatic diversity by setting aside reserves or key watersheds. We do not have the information at this time to determine what areas could serve as reserves for aquatic invertebrates, and it is unlikely that we ever will. We do not know the minimum habitat required to maintain genetic viability of aquatic invertebrate species. Rare and endemic aquatic invertebrates likely occur in every watershed in the Sierra, making every watershed "key" for some species. Endemic aquatic invertebrates are isolated in smaller streams and other small aquatic habitats throughout the Sierra. River basins are continuous systems; what happens upstream affects the downstream biota. Setting aside a piece of a stream or watershed for protection is not a long-term solution, though it may have some immediate benefits. Influences outside the boundaries of reserves (ground-water pumping, air pollution, changes in the ozone layer, exotic species, diseases, burgeoning human population) require us to consider issues far beyond the boundaries of reserves or watersheds and even beyond the Sierra. In short, reserves or key watersheds give a false sense of security about species conservation. Our best hope is to improve analysis, monitoring, and management; protect unspoiled areas; and work toward protection and restoration of all watersheds.

Concentrate on What We Can Change

We must concentrate on what we can change and what we know is having a negative impact on aquatic systems. Sedimentation from logging, roads, livestock grazing, construction of many kinds (housing, ski resorts, hydroelectric projects), and mining is a large problem in the Sierra and causes significant changes in invertebrate assemblages, as was discussed earlier. Reducing sediment in aquatic systems should become a major objective of resource agencies. "Sediment load and deposition constitutes one of the most serious water quality problems throughout the world" (Osborne and Kovacic 1993).

Evaluate Pulse and Press Disturbances

There is a need to recognize the difference between "pulse" disturbances (limited and definable duration) and longer-induration "press" disturbances (Bender et al. 1984; Niemi et al. 1990). Not surprisingly, streams recover more rapidly from pulse disturbances. But recognizing when pulse disturbances may become a continuous press on the system is important. For example, a logging operation that temporarily increases stream sediment or light is a pulse impact from which the system likely will recover within a few years. But continuing logging operations throughout a basin, or a broad network of roads, or a reservoir, or an old mining scar carrying sediment into a stream year after year, or continuous livestock grazing, or all of these together in a watershed become press disturbances and may irrevocably alter habitat and the biota.

Protect Upper Watersheds and Small Aquatic Habitats

Upper watershed streams and small aquatic habitats need far more protection than they are currently receiving. Buffer areas should be increased and should be dependent on landscape factors (slope, soils, geology) as well as stream size. In other words, the steeper the slope, the greater the buffer area should be regardless of stream size. The smaller the water body, the closer its connection to the surrounding land, and the more likely it is to be damaged by activities on the land. Present logging buffers required on private land for small streams are woefully inadequate, but also inadequate are buffers for small streams on public land. To protect the watershed, we must protect the headwaters.

Riparian areas are critical to aquatic habitats and the aquatic biota, and conversely the aquatic biota is a critical food supply to terrestrial animals that inhabit riparian areas. Riparian areas should not be abrupt and isolated zones, as they are presently in many logged areas, but should grade gradually into upland areas.

Protect Temporary Aquatic Habitats

Temporary water should receive the same protective safeguards and buffer areas as permanent water. There is as much biological justification for protecting temporary water as there is for protecting permanent water.

Reduce Total Roaded Area

Total roaded area should be reduced. Road construction around wetland and riparian areas needs more careful scrutiny.

Reduce, Eliminate, or Change Livestock Grazing

Cattle should be eliminated or greatly reduced in riparian and aquatic areas. Sheep should be moved rapidly through wet meadows and spring areas. No grazing of livestock should occur in peatland fens.

Restore Habitat Where Possible

Restoration should focus on eliminating the source of a problem. Some impacts to the Sierran waterscape are beyond complete restoration, but partial restoration may be possible. For example, large reservoirs are permanent and have an enormous impact on river systems; nevertheless, hydrologic regimes can be altered to more normal flows. Some streams, buried by mining spoils, may be beyond recovery.

Do Not Manage Riparian Areas for Fire Protection

Wildfire cannot be anticipated in riparian areas. Therefore, measures taken to prevent wildfire in riparian habitats may cause more harm than good by adding road systems and sediment, by decreasing wood and downed snags, and by opening riparian areas and changing the moist microclimate. Aquatic habitats will be better protected by preventing the known damage caused by known and predictable human activities than by trying to fire proof riparian areas.

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State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME
Wildlife and Habitat Data Analysis Branch
California Natural Diversity Database

SPECIAL ANIMALS (673 taxa)
August 2004

The California Natural Diversity Database (CNDDB) is a continually refined and updated, computerized inventory of location information on the most rare animals, plants, and natural communities in California. The blueprint used to set up the CNDDB was developed by The Nature Conservancy (TNC) in the early 1970's. TNC has helped to set up similar programs in all 50 states and a number of foreign countries. Collectively these programs are known as the Natural Heritage Network. The "Heritage Methodology" used by all of these programs sets the standards on the information we gather and the procedures we use. In 1999 TNC and the Natural Heritage Network jointly established an independent organization, the Association for Biodiversity Information (ABI), to achieve their mutual goal of using the wealth of biodiversity information in the Heritage Network to support conservation efforts. In November 2001 ABI changed its name to NatureServe. More information the Natural Heritage Network is available on the NatureServe web site: http://www.natureserve.org.

EX 2

Comparison of species listed on the California Natural Diversity Database and possible taxa of these species found in the Silver King Creek basin collections, 1984-2006.

Taxa Found Silver King Creek	Taxa in CNDDB	NDDB Rank
Pelecypoda (clams)		
Pisidium	*Pisidium ultramontanum*	G1S1
Coleoptera		
Elmidae		
	Atractelmis wawona	G1G3S1S3
	Dubiraphia brunnescens	G1G3S1S3
	Dubiraphia giulianii	G1G3S1S3
Trichoptera		
Limnephilidae	*Desmona bethula*	G?S?
Farula	*Farula praelonga*	G?S?
Cryptochia	*Cryptochia excella*	G1G3S1S3
	Cryptochia denningi	G?S?
Neothremma	*Neothremma genella*	G?S?
Ecclisomia	*Ecclisomyia bilera*	G1G3S1S3
Hydropsychidae		
*Parapsyche**	*Parapsyche extensa*	GHSH
Lepidostomatidae		
Lepidostoma	*Lepidostoma ermanae*	G?S?
Rhyacophiladae		
Rhyacophila	*Rhyacophila mosana*	G1G3S1S3
	Rhyacophila spinata	G1G3S1S3
Plecoptera		
Leuctridae	*Megaleuctra sierra*	G2QS?

CNDDB ranks are shorthand formulas that provide information on the rarity of a species or subspecies, both throughout its global range (G) and its range within the State (S).
G1=Extremely endangered, G2=Endangered, G3=Restricted range, rare. State Ranks S1 to S5 apply to California.
G1G3 (and S1S3)=ranks somewhere inbetween, G? or S? means insufficient data to rank,
G2QS?=species is endangered but there is some taxonomic questions.
(from Appendix 1, California Natural Diversity Database online)
*=collected in 2007 samples in Silver King Creek

SPECIES COMPOSITION, EMERGENCE, AND HABITAT PREFERENCES OF TRICHOPTERA OF THE SAGEHEN CREEK BASIN, CALIFORNIA, USA

Nancy A. Erman[1]

ABSTRACT.—An extensive study of larvae and adult Trichoptera of the Sagehen Creek hasin, Sierra Nevada, California, USA, revealed 77 species representing 14 families and 41 genera. Twenty-six species were restricted to small water bodies (spring sources, seeps, spring streams, temporary ponds, and intermittent streams); 27 were restricted to Sagehen Creek, a second-order stream, and the mouths of two large spring streams. Similarity between species caught at black lights and those in emergence traps was 43%. There were two major peaks in adult emergence by species, midsummer and late summer–fall. A few species emerged during winter or throughout most of the year. The species composition of the community showed affinity with Oregon, the Great Basin, and the Rocky Mountains but very little similarity with the California Coast Range. Four of the most abundant species in the basin have very restricted distributions. Ecological separation of several groups of closely related species could be explained by major differences in larval habitats or by different emergence periods.

Trichoptera from the Sierra Nevada of California have been collected and described in papers over the last several decades, but no comprehensive studies of species abundance and distribution exist for the Sierra Nevada or for any part of it. The Sagehen Creek basin on the east side of the Sierra Nevada bas been the site of a University of California field station and of numerous aqnatic biology studies since 1951. Trichoptera from this watershed have been critical to several systematic (i.e., Denning 1970, Wiggins 1973, 1977, Parker and Wiggins 1985) and behavioral studies (Erman 1981, 1984, 1986, 1987). Other aquatic invertebrate work in the Sagehen Creek basin is extensive. A comprehensive list of the stoneflies was published by Sheldon and Jewett (1967) and updated by R. Baumann, W. Shepard, B. Stark, and S. Szczytko for the first North American Plecoptera Conference in 1985 (nnpublished). Plecoptera material from the Sagehen Creek basin has contributed to many systematic (Jewett 1966, Surdick 1981, Szczytko and Stewart 1979, 1984) and ecological stndies (Sheldon 1969, 1972, 1980).

The Turbellaria have been studied (Kenk 1970, 1972) as has the amphipod genus *Stygobromus* (Holsinger 1974); and the *Cricotopus-Nostoc* relationship was first described in Sagehen Creek (Brock 1960). The aquatic invertebrate community and secondary production in peatlands have been examined (Erman and Erman 1975).

The primary objectives of the present study were to determine the species composition, emergence periods, and habitat preferences of the Trichoptera community of the Sagehen Creek basin. As the study progressed, secondary objectives emerged, such as a comparison of collecting methods, development of emergence collection techniques for remote areas, and examination of some taxonomic problems.

STUDY AREA

Sagehen Creek basin is on the east side of the northern Sierra Nevada, Nevada and Sierra counties, California, and on the western edge of the Great Basin in the Lahontan drainage. It includes 2,700 hectares from its headwaters (elevation 2,256 m) to its end in Stampede Reservoir (elevation 1,804 m). Mean annual precipitation is 93 cm, most of which falls as snow. Mean annual temperature at the field station measuring station (1,943 m) is 4.9 C, and temperatures below freezing can occur in any mouth. Within the Sagehen Creek basin is a wide diversity of aquatic habitats. In addition to the second-order, spring-fed Sagehen Creek, there are many permanent, constant-temperature springs (3.5–9 C) and spring streams of various sizes and physical-chemical conditions, several minerotrophic peatlands (fens) in different stages of evolution (Erman 1976, Bartolome et al. in press), a

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EX 3

small cirque pond at the head of the basin that dries completely about two out of three years, and temporary streams that exist each year for varying time periods.

METHODS

Adults were collected with emergence traps, black lights, hand nets, and fish traps. Emergence traps were of two types: one, a 1×1-m base pyramidal trap with collecting bottle (80% alcohol) that was emptied at one- or two-week intervals; the other, a smaller folding trap that could be easily moved to more remote sites. During the six years of the study over 800 one- or two-week emergence trap samples were collected in 22 locations in the basin, including spring sources, spring streams (first-order streams), an intermittent stream, and Sagehen Creek. Fish traps, nsed in other studies, were closed screen boxes, open only on the ends. They extended above the water and were emptied from the hinged top (see Erman and Leidy 1975). They were useful for collecting both larval and adult caddisflies. Black lights were used in the vicinity of the U.C. field station. One black light was run intermittently in the same location (about 30 m from the nearest water) at the field station from as early as April to as late as October from 1980 to spring 1987. This light was not a trap; specimens were sampled at approximately half-hour to one-hour intervals on 111 nights. Other portable black lights were used in remote areas. Hand-netting and sweep-netting of vegetation were done at many aquatic sites in the basin.

Larvae were collected with kick screens, Surber-type samplers, and scoops. They were also collected by hand-picking. The objective of the combination of sampling techniques was to collect, if possible, all Trichoptera species in the basin and to determine the larval habitats of all species collected. To tbat end, many larvae were also reared. Quantitative sampling was not an objective; however, for comparative purposes, the emergence traps provided data on relative abundance of species.

A reference collection of most species will be placed in the California Academy of Sciences, Golden Gate Park, San Francisco. Some of the more rare species and those for which taxonomic questions have yet to be resolved have been or will be sent to the Royal Ontario Museum, Toronto, Canada.

RESULTS AND DISCUSSION

Species Habitats and Distribution

A total of 77 species representing 14 families and 41 genera were collected in the basin (Table 1). Limnephilidae was the most abundantly represented family with 32 species, followed by Rhyacophilidae with 13 species. Larval habitats were determined for most species and are given in Table 1. Habitats could not be determined for 12 species caught only by black light and for whom larvae were unknown.

Twenty-six species occurred in one small water body or a combination of spring sources, spring seeps, spring streams, temporary ponds, and intermittent streams but not in Sagehen Creek. At least one-third of the species in the basin, then, were restricted to smaller aquatic habitats. Conversely, at least 27 other species, approximately another one-third, were confined to Sagehen Creek and/or near the mouths of the two largest spring streams only. Twelve species were found in both general habitat groups, though they may have shown a preference for one or the other.

Fifteen species from six families showed a variety of adaptations for life in variable habitats at the land-water interface and are discussed in more detail elsewhere (Erman 1981, 1986, 1987). Larvae of *Clostoeca disjuncta* were never found in permanent water. Adults of *Hesperophylax designatus* and *Wormaldia pachita* emerged from an intermittent stream just days before it dried completely. *Limnephilus peltus* left permanent spring streams and pupated in damp moss; in laboratory rearing studies it could not emerge if left in permanent water. A few species (i.e., *Goeracea oregona*, *Allomyia cidoipes*, *Lepidostoma ermanae*) were limited to one or a few springs. The distribution of the species in springs and their requirements will be discussed further in a future paper, the result of a separate study on Sierra Nevada springs.

Species Abundance

Relative abundance of species given in Table 1 is based roughly (a) on number of adults caught during the study, (b) on distribution in numbers of habitats based on emergence trapping, and (c) on an assessment of larval abundances. The ratings shown are, of necessity, somewhat subjective. The 10 species designated as abundant were either caught in very high numbers at black lights and were present as larvae in large nnmbers in Sagehen Creek (7 species), or were caught in high numbers in emergence traps and in many locations (3 species). In this latter group, one species, *Desmona bethula,* inhabits newly flooded areas and fluctuates greatly in numbers from year to year (Erman 1981). Thus, it may not always be abundant. Both it and *Limnephilus peltus,* discussed above, have an apparently limited range in the Sierra Nevada but occur, at least periodically, in great abundance in the Sagehen Creek basin (see also Denning 1965).

Thirty-six species are listed here as common, and 31 are considered rare. In the rare group are 2 species that occur in rather high numbers but were found in only one habitat or a few small ones within the basin. These are *Goeracea oregona* (in one spring only) and *Parthina linea* (a few spring areas). *Parthina linea* exhibits an elaborate, nearly flightless mating behavior on riparian vegetation (Erman 1984), which may partly explain its limited distribution. Females may be flightless. Similar behavior has been observed in the limnephilid *Psychoronia costalis* (Scott Herrmann, personal communication), also confined to spring seeps and small streams.

Trapping Success and Differences

Fifty-seven species were caught in emergence traps, and 52 were caught at black lights (Table 1). Thirty-three species were trapped by both methods. Thus, 24 species caught in emergence traps were never caught at black lights, and 19 species caught by black lights were not caught in emergence traps. One species, *Dicosmoecus gilvipes,* was caught only by hand-netting and by larval rearing. These results give a trapping similarity of 43% (using Jaccard's Index, Pielou 1984) between the methods and indicate the value of nsing different trapping methods to determine total species in a given geographical area.

Most species not canght at black lights were from the springs and spring streams (Table 1) and/or emerged during a season other than summer (Fig. 1). Many factors, such as location of trap in relation to microhabitat of a species, diel flight activity, time of year of emergence, and attraction to light, affect trapping success and could be considered on a species-by-species basis. The objective of this study, however, was not to stndy reasons for trapping success but to collect all species possible, and no attempt was made to quantify trapping effort for each technique.

Fish traps were considered emergence traps for the foregoing comparison. They accounted for collection of only four species that were not otherwise caught in emergence traps. They may catch caddisflies, however, during up- or downstream flight rather than during emergence.

Adult Flight Periods and Community Emergence Patterns

Emergence periods are shown for each species in Figure 1. Species are listed in order of emergence (and, within that category, alphabetically by family and species) beginning with January. The year was divided into 52 numbered weeks by eliminating 29 February and 31 December, as in the Rothamsted Insect Survey (Crichton 1971). To save space in this paper (Figs. 1, 2), I have begun with week 14 (2–8 April) and ended with week 44 (29 October–4 November). Traps were run, however, at some sites year-ronnd, and the following four species were collected in late autumn, winter, and early spring: *Psychoglypha klamathi, P. mazamae, P. ormiae,* and *Wormaldia occidea.* The fonr Sagehen *Psychoglypha* species (including *P. bella*) do not emerge in the summer period. *Wormaldia occidea,* on the other hand, was collected at constant-temperature springs during every month of the year and apparently has a nonseasonal life cycle. *Rhyacophila oreta* began emerging in early February and was collected in every week through September. It had a similar long, nonseasonal emergence period in the Salmon River basin of Idaho (Smith 1968). Four other species (*Desmona bethula, Rhyacophila ardala, R. vaccua,* and *R. verrula*) were occasionally trapped in November and December.

There are two major peaks in adult emergence in the Sagehen Creek basin Trichoptera community. One is the midsummer peak in late June and July. The other is the late summer–fall peak that begins as the temperature cools in Augnst. At least 20 species in the

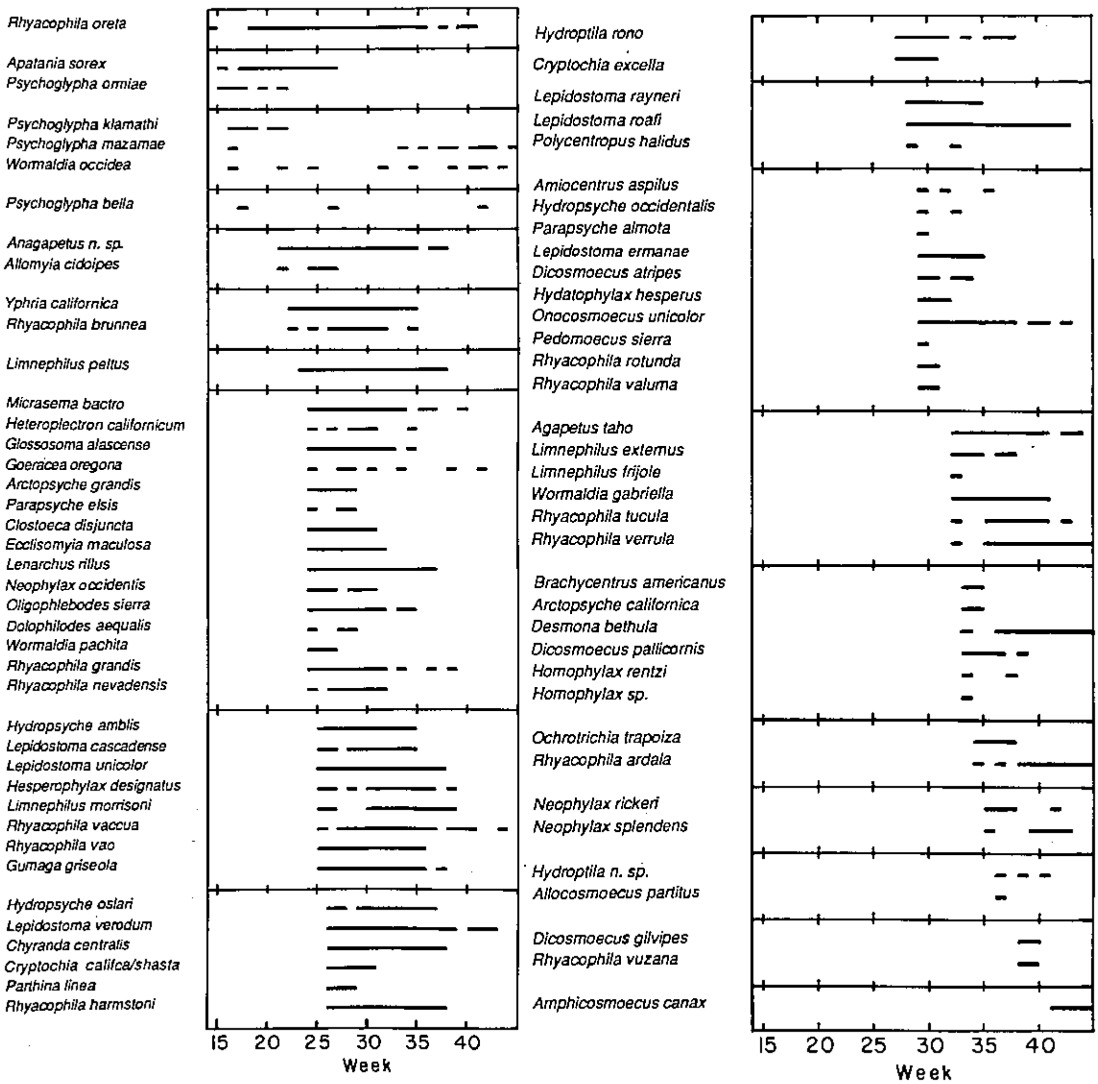

Fig. 1. Adult emergence periods of Trichoptera from the Sagehen Creek basin, by week, 2 April–4 November.

basin are in this latter category. Adult activity patterns for rarely caught species with no larval information must be considered inconclusive. The combined species emergence (Fig. 2) for 1979–1986 shows a pronounced increase in emergence in week 24 (11–17 June). This pattern is plotted against air temperature, water temperature in Sagehen Creek (means from 1979 to 1986), and solar radiation (taken as the mean monthly radiation published for a similar latitude—Reno, Nevada). No correlation is obvious to explain the sudden rise in numbers of emerging species. There is, however, an obvious association between the overall emergence pattern and these three physical factors. The solid bars represent all species in the basin; the open bars, Sagehen Creek species only. It sbould be remembered that the water temperature curve in Figure 2 does not apply to species living in temporary streams, springs, etc.

Geographical Comparisons

Presence or absence of Sagehen Creek basin species in other geographic areas is

TABLE 1. Species composition, habitat, relative abundance, and capture method for Tricboptera in the Sagehen Creek basin, California. [SC = Sagehen Creek, S = spring origins, SS = spring streams, LSS = largest spring streams only (near mouth), TS = temporary streams, TP = temporary ponds.]

Species	Habitat	Relative abundance	Capture method: Emergence trap	Capture method: Black light	Reared or associated larvae
Brachycentridae					
Amiocentrus aspilus (Ross) 1938	?	R		X	
Brachycentrus americanus (Banks) 1899	SC[1]	R		X	X
Micrasema bactro Ross 1938	SC,S,SS	A	X	X	X
Calamoceratidae					
Heteroplectron californicum McLachlan 1871	SC,LSS	C	X	X	X
Glossosomatidae					
Agapetus taho Ross 1947	SC,LSS	C	X	X	X
Anagapetus sp.	SC,S,SS	A	X	X	X
Glossosoma alascense Banks 1900	SC	A	X	X	X
Goeridae					
Goeracea oregona Denning 1968	S[2]	R[5]	X		X
Hydropsychidae					
Arctopsyche californica Ling 1938	?	R		X	
Arctopsyche grandis (Banks) 1900	SC	C	X	X	X
Hydropsyche amblis Ross 1938	SC,LSS	A	X	X	X
Hydropsyche occidentalis Banks 1900	?	R		X	
Hydropsyche oslari Banks 1905	?	R		X	
Parapsyche almota Ross 1938	LSS	R	X		
Parapsyche elsis Milne 1936	LSS	R	X		
Hydroptilidae					
Hydroptila rono Ross 1941	SC,SS[3]	C	X	X	X
Hydroptila sp.	SC	R	X	X	
Ochrotrichia trapoiza Ross 1947	SS[3]	R	X		
Lepidostomatidae					
Lepidostoma cascadense (Milne) 1936	SC,SS	C	X	X	
Lepidostoma rayneri Ross 1941	?	C		X	
Lepidostoma roafi (Milne) 1936	SC,S,SS	A	X	X	X
Lepidostoma unicolor (Banks) 1911	SC,S,SS	C	X	X	
Lepidostoma verodum Ross 1948	S,SS	C	X		
Lepidostoma ermanae Weaver 1988	S[4]	R	X		X
Limnephilidae					
Allocosmoecus partitus Banks 1943	SC	R		X	X
Allomyia cidoipes (Schmid) 1968	S[4]	R	X		X
Amphicosmoecus canax (Ross) 1947	SC,LSS	C	X		X
Apatania sorex Ross 1941	SC,LSS	C	X		X
Chyranda centralis (Banks) 1900	SC,S,SS	C	X	X	X
Clostoeca disjuncta (Banks) 1914	TS	C	X	X	X
Cryptochia califca/shasta Denning 1968, 1975	SS	R	X		
Cryptochia excella Denning 1964	S,SS	R	X		
Desmona bethula Denning 1954	S,SS,SC	A	X		X
Dicosmoecus atripes (Hagen) 1875	SC,LSS	C		X	X
Dicosmoecus gilvipes (Hagen) 1875	SC[1]	C			X

shown in Table 2. Comparisons were made with published, comprehensive Trichoptera lists from the state of Oregon, from the H. J. Andrews Forest in the western Cascades of Oregon, from Utah, Colorado, southeast Alaska, the Yukon, and from two Pacific Coast Range streams in California (Anderson 1976, Anderson et al. 1982, Baumann and Unzicker 1981, Herrmann et al. 1986, Vineyard 1982, Nimmo and Wickstrom 1984, McElravy and Resh 1987). No attempt was made here to show total range of each species. The purpose is to show where the Sagehen Creek basin Trichoptera community has affinities with other western North America Trichoptera, which Sagehen Creek basin species are widely

Table 1 continued.

Species	Habitat	Relative abundance	Capture method: Emergence trap	Capture method: Black light	Reared or associated larvae
Dicosmoecus pallicornis Banks 1943	?	C		X	
Ecclisomyia maculosa Banks 1920	SC, LSS	C	X	X	X
Hesperophylax designatus Banks 1943	TS, S, SS	C	X		X
Homophylax rentzi Denning 1964	S[4]	R		X	
Homophylax sp.	S	R	X		
Hydatophylax hesperus (Banks) 1914	?	R		X	
Lenarchus rillus (Milne) 1935	TS, TP, S, SS	C	X	X	X
Limnephilus externus Hagen 1861	TP	C		X	X
Limnephilus frijole Ross 1944	?	R		X	
Limnephilus morrisoni Banks 1920	TS, SS	C	X	X	X
Limnephilus peltus Denning 1962	S, SS	A	X	X	X
Neophylax occidentis Banks 1924	SC	C	X	X	X
Neophylax rickeri Milne 1935	?	R	X	X	
Neophylax splendens Denning 1948	S, SS	R	X	X	
Oligophlebodes sierra Ross 1944	SC	A		X	X
Onocosmoecus unicolor Banks 1897	SC, LSS	C	X	X	X
Pedomoecus sierra Ross 1947	?	R		X	
Psychoglypha bella (Banks) 1903	SC	C		X	X
Psychoglypha klamathi Denning 1970	SS	R		X	
Psychoglypha mazamae Denning 1970	S, SS	C	X		X
Psychoglypha ormiae (Ross) 1938	S	R	X		
Odontoceridae					
Parthina linea Denning 1954	S[2], SS	R[5]	X		X
Philopotamidae					
Dolophilodes aequalis (Banks) 1924	SC	R	X	X	X
Wormaldia gabriella (Banks) 1930	SC, LSS	C	X	X	
Wormaldia occidea (Ross) 1938	S	C	X		
Wormaldia pachita Denning 1956	TS	R	X		
Phryganeidae					
Yphria californica (Banks) 1970	SC, S[2], SS	C	X	X	X
Polycentropodidae					
Polycentropus halidus Milne 1936	SC	R	X		
Rhyacophilidae					
Rhyacophila ardala Denning 1965	S, SS	A	X		X
Rhyacophila brunnea Banks 1911	SC, LSS, S[2]	C	X	X	X[6]
Rhyacophila grandis Banks 1911	S, SS	C	X	X	X
Rhyacophila harmstoni Ross 1944	SC, S, SS	A	X	X	X
Rhyacophila nevadensis Banks 1924	SC	C	X	X	X
Rhyacophila oreta Ross 1941	S	C	X		X
Rhyacophila rotunda Banks 1924	?	R		X	
Rhyacophila tucula Ross 1950	SC, LSS	C	X	X	X
Rhyacophila vaccua Milne 1936	SC, S, SS	C	X	X	X
Rhyacophila valuma Milne 1936	?	R		X	
Rhyacophila vao Milne 1936	SC, LSS	C	X	X	X[6]
Rhyacophila verrula Milne 1936	S, SS	C	X		X
Rhyacophila vuzana Milne 1936	SC	R	X		X
Sericostomatidae					
Gumaga griseola (McLachlan) 1871	S[2], SS[3], SC	C	X	X	X

[1]Lower Sagehen Creek only.
[2]Warmest (9 C) springs only.
[3]Warmest stretches of spring streams only (max. temp. approx. 27 C).
[4]Coldest springs (approx. 3.5–4.5 C).
[5]Habitat restricted but species abundant in that habitat.
[6]Cannot distinguish *R. vao* larvae from *R. brunnea* larvae.

distributed, and which are restricted in range.

In comparing the Sagehen Creek basin species with other areas, I have considered the following species synonyms based on recently published papers: *Lepidostoma mira* is a synonym of *L. cascadense* (Weaver 1988), *Hesperophylax incisus* is a synonym of *H. designatus* (Parker and Wiggins 1985), *Rhyacophila acropedes* is a synonym of *R. brunnea* (Smith and Manuel 1984).

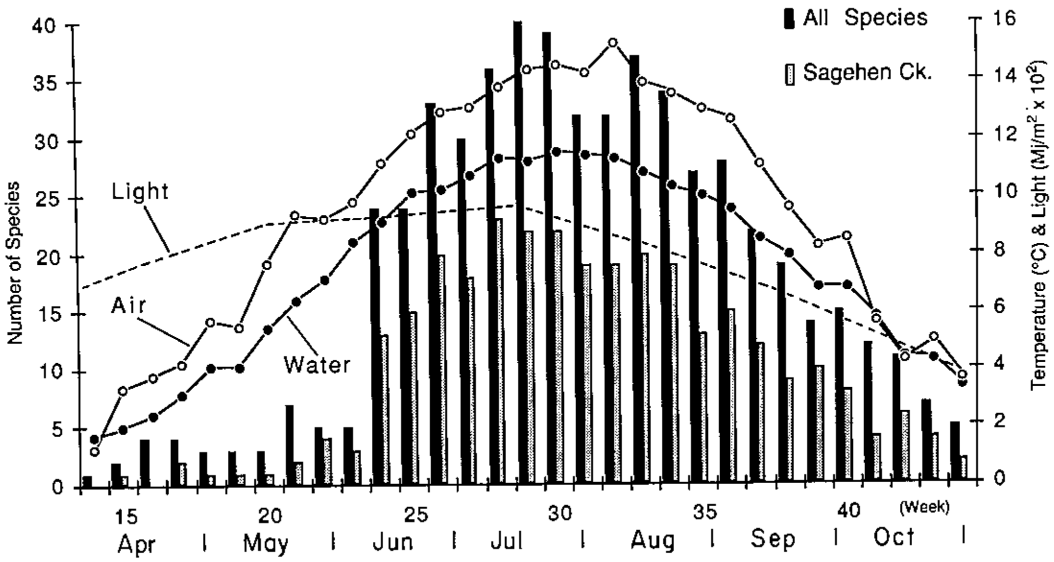

Fig. 2. Weekly emergence of caddisflies from all habitats in the Sagehen Creek basin and from Sagehen Creek only. Air and water temperatures (Sagehen Creek) are weekly means; light is monthly mean solar radiation taken from the nearest recorded site of similar latitude (Reno, Nevada).

Fifty-nine Sagehen Creek basin species are also in Oregon; 36 of these in the western Cascades of Oregon. Thirty-eight species are in common with Utah, 33 with Colorado, 18 with southeast Alaska, 15 with the Yukon, and only 8 with the Pacific Coast Range in California. This latter result may at first seem surprising, except that the California Coast Range has a Mediterranean climate (McElravy and Resh 1987) very different from the short growing season and long, cold winters of the eastern Sierra Nevada. It is apparent that certain species are ubiquitous in western North America (i.e., *Hydropsyche oslari*, *Polycentropus halidus*, *Rhyacophila vao*), and others are probably confined to a small area in the Sierra Nevada. Fifteen Sagehen Creek basin species are found on none of the above regional lists. Of these locally distributed species, it is interesting to note that 4 are among the 10 most abundant species in the Sagehen Creek basin (*Anagapetus* n. sp., *Desmona bethula*, *Limnephilus peltus*, and *Rhyacophila ardala*).

Three species (*Ochrotrichia trapoiza*, *Rhyacophila harmstoni*, and *R. rotunda*) have a wide distribution to the east (Utah and/or Colorado) but not northward. Of course, more extensive collections in eastern Oregon may prove otherwise. Except for those three, all Sagehen Creek basin species found as far east as Utah or Colorado are also found in Oregon.

Hesperophylax magnus was collected from Sagehen Creek on 8 October 1966 (Parker and Wiggins 1985), but it was not collected during the present study. Its earlier presence in Sagehen Creek was the only California site reported and was the westernmost extension of its distribntion.

Taxonomic Considerations

Some of the Sagehen Creek basin species show slight variations from described forms; a few are apparently undescribed species for which descriptions are planned.

Anagapetus sp. is an undescribed species similar to *A. chandleri* and *A. aisha*, but it differs from both in a consistent way.

Hydropsyche amblis is the form designated *H. abella* by Deuning (1952). I am considering it *H. amblis* here, based on information (Pat Schefter, personal communication) that the species varies widely. My designation is tentative until further work is done.

Lepidostoma ermanae, recently described by Weaver (1988), is similar to *L. hoodi* and *L. spicatum*.

Clostoeca disjuncta differs somewhat in both larva and adult from those described.

The larva has a sclerite on the lateral hump of abdominal segment I, unlike that described by Wiggins (1977), and makes a case of sedge pieces. The adult has a prominently marked wing. The species shows wide variation over its range (Glenn Wiggins, personal communication).

The few specimens of *Cryptochia califca/shasta* from the Sagehen Creek basin have characteristics of both species. They were all caught in one spring stream over a span of a few weeks. Further work is underway to collect more specimens by emergence trapping to help resolve the taxonomic questions. Both of these species were originally named from single males (Denning 1968, 1975).

I collected *Ecclisomyia* larvae, but no adults, in very cold springs, 3–4 C, at the head of the basin (elevation 2,408 m). These may be a different species from the *Ecclisomyia maculosa* collected from the larger, warmer streams at a lower elevation (1,943 m).

Neophylax rickeri and *Neophylax splendens* warrant further taxonomic and ecological work in other sites where they occur together and in greater abnndance than in the Sagehen Creek basin (only 11 males and 6 females total were caught during this study). The males were difficult to separate, and separating the females was little more than guesswork. The two species have the same emergence period in the Sagehen Creek basin. Anderson and Wold (1972) reported a similar finding in Oregon where the two species appeared in the same emergence traps during the same interval in October. *Neophylax splendens* may be a synonym of *N. rickeri*.

A similar situation is true for *Rhyacophila brunnea* and *R. vao*. These species are already known to vary widely (Smith and Manual 1984). Three distinct forms were found during this study, two variants of *R. brunnea* and one of *R. vao*. A few specimens seemed intermediate between the two species. Both species were collected in the same emergence traps at the same time and in the same sweep nets. I have separated the males but think they very likely may be one highly variable species.

Ecological Separation of Some Closely Related Species

Some closely related species in the Sagehen Creek basin, like the three species of *Wormaldia*, occur in completely different aquatic habitats. *Wormaldia pachita* was found in one temporary stream where it emerged just prior to the complete drying of the stream. *Wormaldia occidea*, on the other hand, occurs in constant-temperature springs and emerges year-round. And *W. gabriella* lives iu Sagehen Creek and large spring streams only.

Other related species were found in the same habitat but were ecologically separated by the timing of their life cycles. *Agapetus taho*, *Anagapetus* sp., and *Glossosoma alascense*, with similar larvae, all occur in Sagehen Creek but are separated by emergence periods. *Anagapetus* sp. emerges primarily in early summer, *G. alascense* in midsummer, and *A. taho* in late summer and fall. In addition, *A*. sp. is adapted to large and small spring streams as well as Sagehen Creek; *G. alascense* is restricted to Sagehen Creek (Table 1). Other species of these three genera often occur in the same streams (Anderson and Wold 1972).

It is interesting that so many Dicosmoecinae are fouud in the Sagehen Creek basin, including the three possible species of *Dicosmoecus* and the closely related *Allocosmoecus*. None of these four species was caught in emergence traps, but larval rearings showed that, as predicted by Wiggins and Richardson (1982), *D. gilvipes* and *D. atripes* tended not to be at the same site. *Dicosmoecus gilvipes* larvae live farther downstream in more open, warm areas of Sagehen Creek, and adults emerge later than *D. atripes* (Fig. 1). Larvae of *A. partitus* were infrequently found in the same section of Sagehen Creek as *D. atripes*, but the preferred larval habitats of *A. partitus* and *D. pallicornis* are unknown in the Sagehen Creek basin.

The four species of *Psychoglypha* have similar emergence periods, but *P. bella* is restricted to Sagehen Creek and *P. mazamae* (larvae and adults) is found in warmer downstream sections of small spring streams than are the adults of *P. ormiae* and *P. klamathi*. I have not successfully reared or associated with adults the larvae of these latter two and do not know if the larvae can be distinguished from each other.

The habitat differences of *Chyranda centralis* and *Clostoeca disjuncta* are worth noting because of their similar larvae and cases.

TABLE 2. Presence of Trichoptera species of the Sagehen Creek basin in other western North American areas.

Sagehen Creek basin species	Oregon[1]	Western Cascades[2] (Oregon)	Utah[3]	Colorado[4]	Southeast Alaska[5]	Yukon[6]	Coast Range[7] (California)
Brachycentridae							
Amiocentrus aspilus	X	X	X	X			X
Brachycentrus americanus	X	X	X	X			
Micrasema bactro	X	X	X	X	X	X	
Calamoceratidae							
Heteroplectron californicum	X	X					X
Glossosomatidae							
Agapetus taho	X						X
Anagapetus sp.							
Glossosoma alascense	X		X	X	X	X	
Goeridae							
Goeracea oregona	X						
Hydropsychidae							
Arctopsyche californica							
Arctopsyche grandis	X	X	X	X		X	
Hydropsyche amblis	X						
Hydropsyche occidentalis	X		X	X			X
Hydropsyche oslari	X	X	X	X		X	X
Parapsyche almota	X		X	X			X
Parapsyche elsis	X	X	X	X	X	X	
Hydroptilidae							
Hydroptila rono	X		X	X		X	
Hydroptila sp.							
Ochrotrichia trapoiza			X	?			
Lepidostomatidae							
Lepidostoma cascadense	X	X	X	X		X	
Lepidostoma rayneri	X						
Lepidostoma roafi	X	X	X	X	X	X	
Lepidostoma unicolor	X	X	X	X			
Lepidostoma verodum	X	X					
Lepidostoma ermanae							
Limnephilidae							
Allocosmoecus partitus	X	X					
Allomyia cidoipes	X						
Amphicosmoecus canax	X		X	X			
Apatania sorex	X	X	X				
Chyranda centralis	X		X	X	X	X	
Clostoeca disjuncta	X						
Cryptochia califca/shasta							
Cryptochia excella							
Desmona bethula							
Dicosmoecus atripes	X		X	X	X	X	
Dicosmoecus gilvipes	X	X	X	?			
Dicosmoecus pallicornis							
Ecclisomyia maculosa	X	X	X	X			
Hesperophylax designatus	X		X	X			

Though in separate monospecific genera, they are in the same tribe (Stenophylacini) and in the study area can occur in streams that are separated by only a few meters. However, *Clostoeca* is never in a permanent stream and *Chyranda* is never in a temporary one. The upstream movements of *Chyranda* toward cooler water prior to pupation have been documented (Erman 1986). The last instar and pupa of *Clostoeca* are difficult to find. *Clostoeca* may pupate in damp, decaying organic matter as small streams dry. I have observed *Clostoeca* adults flying upstream over dry runs in early summer, presumably to lay eggs, and in late fall I have collected early instars at the same sites. The same habitat separation of

Table 2 continued.

Sagehen Creek Basin species	Oregon[1]	Western Cascades[2] (Oregon)	Utah[3]	Colorado[4]	Southeast Alaska[5]	Yukon[6]	Coast Range[7] (California)
Homophylax rentzi							
Homophylax sp.							
Hydatophylax hesperus	X	X					
Lenarchus rillus	X				X		
Limnephilus externus	X	X	X	X	X	X	
Limnephilus frijole	X			X			
Limnephilus morrisoni	X						
Limnephilus peltus							
Neophylax occidentis	X	X	X				
Neophylax rickeri	X	X			X		
Neophylax splendens	X	X	X	X			
Oligophlebodes sierra	X	X	X	X	X		
Onocosmoecus unicolor	X	X	X	X	X	X	
Pedomoecus sierra	X	X					
Psychoglypha bella	X	X					
Psychoglypha klamathi	X						
Psychoglypha mazamae							
Psychoglypha ormiae	X		X	X			
Odontoceridae							
Parthina linea	X	X					
Philopotamidae							
Dolophilodes aequalis	X		X	X			
Wormaldia gabriella	X	X	X	X		X	
Wormaldia occidea	X						
Wormaldia pachita							
Phryganeidae							
Yphria californica	X						
Polycentropodidae							
Polycentropus halidus	X	X	X	X	X		X
Rhyacophilidae							
Rhyacophila ardala							
Rhyacophila brunnea	X	X	X	X		X	
Rhyacophila grandis	X	X			X		
Rhyacophila harmstoni			X	X			
Rhyacophila nevadensis				?			
Rhyacophila oreta	X	X	X	?			
Rhyacophila rotunda			X	X			
Rhyacophila tucula	X	X			X		
Rhyacophila vaccua	X	X			X		
Rhyacophila valuma	X	X	X	X	X		
Rhyacophila vao	X	X	X	X	X	X	X
Rhyacophila verrula	X	X	X	X	X		
Rhyacophila vuzana	X	X					
Sericostomatidae							
Gumaga griseola	X		X				
Total species in common	59	36	38	33	18	15	8

[1] Anderson 1976
[2] Anderson et al. 1982
[3] Baumann and Unzicker 1981
[4] Herrmann et al. 1986
[5] Vineyard 1982
[6] Nimmo and Wickstrom 1984
[7] McElravy and Resh 1987

larvae of these two genera has been found in the western Sierra Nevada (Rich Bottorff, personal communication).

Most of the Sagehen *Rhyacophila* are in separate taxonomic groups (Ross 1956, Schmid 1970). Ross and Schmid placed *R. grandis* in the same group with *R. brunnea* and *R. vao*, already discussed; Smith, however, separates *R. grandis* on the basis of larval gills (S. D. Smith, Department of Biological Sciences, Central Washington University, Ellensburg, Washington 98926, unpublished

Key to larvae of Nearctic species groups of *Rhyacophila*, available from author). *Rhyacophila ardala* and *R. vaccua* are the only other pair of closely related *Rhyacophila*. They keyed to the same place in Smith's key but conld be separated by head length vs. head width and by correlation with adults from emergence traps. It was then apparent that their habitats are different. *Rhycophila ardala* occurred in cold spring sources, and *R. vaccua* was primarily in Sagehen Creek and near mouths of spring streams close to Sagehen Creek.

CONCLUSIONS

Though the eastern Sierra Nevada is dry and has a brief growing season, a wide diversity of small aquatic habitats, both permanent and intermittent, seems to account for a large and diverse Trichoptera community with species adapted to nearly every aquatic possibility. Similar detailed studies in other Sierra Nevada basins on both east and west sides and in eastern Oregon and Nevada are needed to increase our understanding of Califoruia Trichoptera communities. It is unfortunate that, although Trichoptera systematists have collected in California for a long time, so little detailed informatiou about caddisfly communities is known for this state. With ever-increasing demands being made on California waters, aud recently on the smaller streams and springs of the Sierra Nevada, a great wealth of evolutionary, ecological, aud biogeographical information concerning Trichoptera may be lost before it is ever documented.

ACKNOWLEDGMENTS

I thank the late Dou Denning, Glenn Wiggins, Pat Schefter, Stamford Smith, and John Weaver for their help with verification of species and resolution of taxonomic questions. I am grateful to the following people for emptying traps at different times during the study: Chris Kellner, Vernon Hawthorne, Mike Yoder-Williams, Joe Thornton, Wayne Spencer, and Lynn Decker. And my thanks to Don Erman for editorial and field assistance. Partial funding was provided by the Uuiversity of California Water Resources Center, Project UCAL-WRC-W-645.

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If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
If inhaled	• Move person to fresh air. • If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
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EX 4

California Fish and Game 90(3):101-118 2004

CONSERVATION OF PAIUTE CUTTHROAT TROUT: THE GENETIC LEGACY OF POPULATION TRANSPLANTS IN AN ENDEMIC CALIFORNIA SALMONID

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Paiute cutthroat trout, *Oncorhynchus clarki seleniris*, are threatened by loss of genetic diversity, restricted distributions, and historical hybridization with other introduced trout species. In this study, we used a single copy nuclear (scnDNA) marker and several nuclear microsatellites to assess levels of rainbow trout (RT) hybridization, estimate existing amounts of genetic variation, and characterize relationships among nine populations of Paiute cutthroat trout (PCT). No evidence of RT introgression was found in any of the PCT populations based on an scnDNA marker and five microsatellite loci. The two polymorphic microsatellite markers revealed population heterozygosities ranging from 0.138-0.657 (average=0.469) and 0.336-0.722 (average=0.544), respectively. Allele frequency distributions differed significantly from Hardy-Weinberg equilibrium in a single sample at one locus. Log-likelihood *G* tests and population pairwise F_{ST} estimates indicated significant differentiation among most of the samples, and a neighbor-joing phenogram of D_{CE} genetic distances revealed genetic relationships among populations that closely reflected PCT stocking history. Results support that efforts to eradicate hybridized PCT have been successful. However, the remaining populations are fragmented with limited genetic variation.

INTRODUCTION

The Paiute cutthroat trout, *Oncorhynchus clarki seleniris*, is a narrowly distributed form of cutthroat trout most closely related to the more widespread Lahontan cutthroat, *O. c. henshawi*, of eastern California, Nevada, and southern Oregon (Nielsen and Sage 2002). Historically, Paiute cutthroat trout (PCT) were probably restricted to an approximately 10-km stretch of Silver King Creek below Llewellyn Falls and above Silver King Canyon gorge (Fig. 1), which effectively isolated them from Lahontan cutthroat trout (LCT) inhabiting the adjacent East Fork Carson River. Over time, PCT evolved distinct phenotypic characteristics, including an almost complete lack of body spotting and an iridescent hue, which distinguished them from other cutthroat and rainbow trout (RT) populations. Snyder (1933, 1934) first recognized PCT as a subspecies based on

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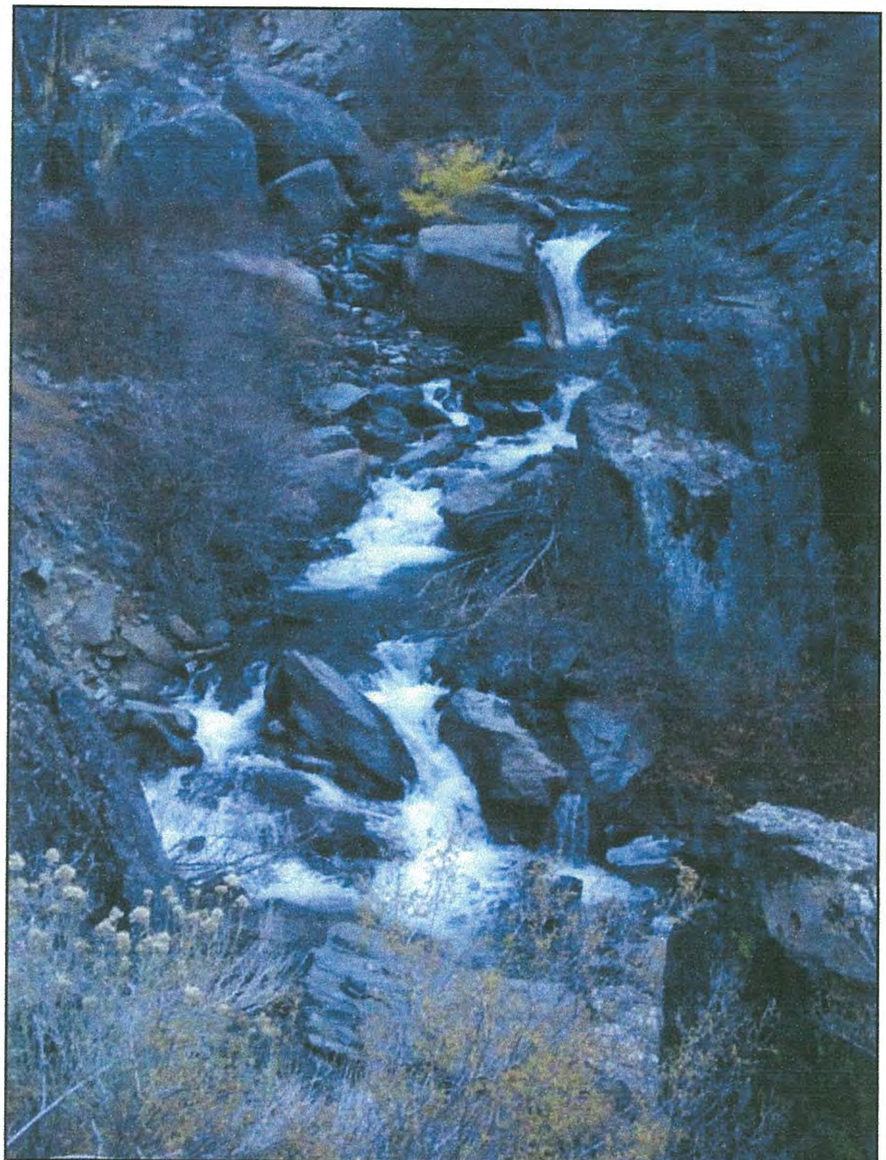
EX 5

Table 2. Characteristics of 7 microsatellite loci evaluated for use in this study. Size ranges are given in base pairs (bp). All microsatellite primer sets are from Rexroad et al. (2001).

Microsatellite Loci	Paiute Cutthroat Trout		Lahontan Cutthroat Trout		Rainbow Trout	
	# alleles	Size range	# alleles	Size range	# alleles	Size range
OMM 1050	1	220	4	224-236	8	240-280
OMM 1051	1	428	5	400-496	7	232-276
OMM 1058	4	216-228	3	208-216	7	184-240
OMM 1086	1	194	3	194-202	5	194-242
OMM 1088	6	204-224	5	144-240	5	120-140
OMM 1104	1	224	1	240	5	168-216
OMM 1108	1	156	6	144-176	4	148-188

50 mM $MgCl_2$, 0.05 μl Taq I polymerase (0.25 U total), 0.2 μl of 1 mM labeled forward primer, 0.4 $\mu$of 10 mM reverse primer, and 2 μl PCT sample DNA (approximately 10 ng total). PCR amplification conditions were the same as described above. Alleles were separated electrophoretically on a 5.5% polyacrylamide gel using the MJ Research BaseStation gel analysis system (MJ Research, Inc., Boston, Ma, USA) and analyzed using MJ Research's Cartographer software. The Genescan 500 size standard (MJ Research) labeled with ROX fluorescent dye was run in each lane.

An anonymous single copy nuclear (ascnDNA) marker was developed following protocols established in the Genomic Variation Laboratory at the University of California, Davis (Tranah et al. 2003). Briefly, 200 ng of DNA from RT, LCT, and PCT samples were digested for 1 hour at 37 °C with the restriction enzymes EcoRI and Mse I using 0.1 μl of each enzyme, 2.0 μl 10X buffer, 0.16 μl 400X BSA, and ddH_2O to 16 μl. Adapters to Mse I and EcoRI restriction sites were then ligated to the ends of the DNA fragments by adding 0.4 μl Eco Adapter (5 pmoles), 0.4 μl Mse Adapter (50 pmoles), 0.2 μl 100mM ATP, 0.2 μl T4 DNA Ligase, 0.4 μl 10x buffer, 0.1 μl 400X BSA, and 2.3 ml H_2O to the 16 ml reaction. The ligation reaction was performed overnight at room temperature, after which 180 μl TLE was added. The adapters were designed to have a final 3' nucleotide that was different from the original sequence, thus destroying the original restriction site. The fragments were then amplified via PCR using primers complimentary to the adapter sequences. The primers used were designed with one to three varying nucleotides overhanging the 3' end of the adapters. Fragments were selectively amplified by varying the specific primers that were used. Fragments were first amplified using shorter, less specific preamp primers. The PCR conditions were: 94°C for 1.5 minutes, followed by 94°C for 30 seconds, 56°C for 30 seconds, and 72°C for 1 minute for 23 cycles; 180 μl of TLE were added to the preamp PCR product for each sample. Fragments were then amplified with different combinations of the specific primers, using a touchdown PCR program with a denaturing step of 94°C for 30 seconds, an annealing step beginning at 65°C for the first cycle and decreasing 0.7°C each cycle until 56°C for 30 seconds, and an elongation step of 72°C for 1 minute. Thirty-five cycles



Site 6a: Silver King Creek, Carson Ranger District. Upstream photo of the waterfall at Site 6 and the steep canyon downstream of the barrier.

The Ecological Angler
ECOANGLER.COM

HOME FLY PATTERNS HABITAT SPECIES REVIEWS ABOUT

East Fork - Carson River

CARSON FLY PATTERNS

MAP OF AREA

FLOW INFORMATION

REGULATIONS

East Fork Carson River - Hangman's Bridge to Nevada Stateline

The Carson River basin encompasses almost 4,000 square miles in California and Nevada. The Carson basin is south of Lake Tahoe and north of the Walker River. The Carson's headwaters are in the Sierra Nevada and flow eastward to drain into the marshes of the Stillwater National Wildlife Refuge. Eventually the water terminates into the Carson Sink. Roughly eighty-five percent of the watershed lands are in Nevada. However, some of the prime trout water is located near the headwaters in California.

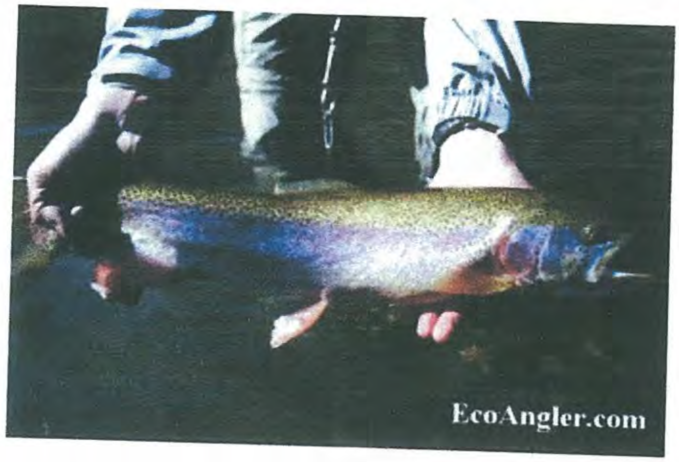
The *EcoAngler Report*

Planning a trip to the East Fork Carson River? Get scientific based angling intel in **The EcoAngler Report - East Fork Carson River**.

Detailed information on the East Fork Carson's native and wild trout populations along

EX 7

available along Highway 89.



In my recent trips to the East Fork I have not netted a single brown trout. (Today fish plants continue to happen upstream of Hangman's bridge and below the confluence with Wolf Creek). Over the years, the hold overs from the earlier plants have grown nicely with several rainbows holding in larger pools over 20 inches.

WILD AND SCENIC - THE EAST FORK

A portion of the east fork, from the town of Markleeville downstream to the state line, is included in California's wild and scenic river system. Some of the upper segments (e.g., below Hangman's bridge) are designated as wild-trout waters and special regulations apply. Please refer to California DFG's Regulations for further details. As with other high elevation streams, it's important to know the current and prior flows when fishing the East Fork of the Carson River.

SILVER KING CREEK

A RARE OPPORTUNITY TO FISH A CREEK THAT HAS BEEN CLOSED FOR OVER FORTY YEARS!

IT STARTED WITH THIS INVITATION FROM ROGER BLOOM, SENIOR FISHERIES BIOLOGIST, CALIFORNIA DEPARTMENT OF FISH AND GAME.

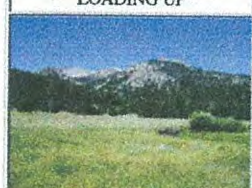
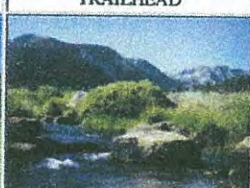
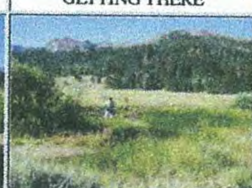
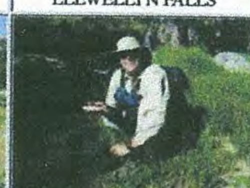
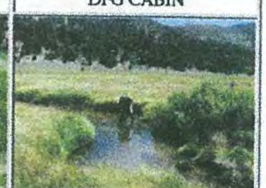
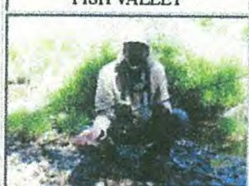
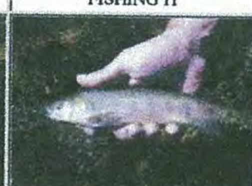
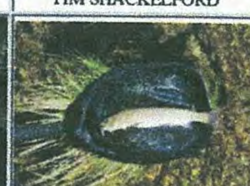
Heritage & Wild Trout Program

Congratulations!

You have been selected to participate in a unique study to assess the potential for a fishery in Silver King Creek (Alpine County). Please read the information below to help better understand the project and what will be expected of you as a volunteer. This is a once in a lifetime opportunity and we hope that you are as excited as we are! Please feel free to contact me if you have any questions.

EXCITED, YOU BET I WAS! HAVING THE CHANCE TO FISH THIS CLOSED WATER AS PART OF THE DFG STUDY, ALSO WOULD ENABLE ME TO CATCH A PAIUTE CUTTHROAT THE RAREST CALIFORNIA HERITAGE TROUT AND WOULD GIVE ME TEN OF THE ELEVEN SUB-SPECIES. I COULD NOT PASS UP THIS UNBELIEVABLE OPPORTUNITY!

FOR MORE INFORMATION ON THIS STUDY AND CALIFORNIA'S HERITAGE TROUT, USE THIS LINK HTC

				
LOADING UP	TRAILHEAD	GETTING THERE	LLEWELLYN FALLS	DFG CABIN
				
FISH VALLEY	SILVER KING CREEK	FISHING IT	TIM SHACKELFORD	CHRIS BELL NETS ONE
				
STEVE COOPER	A PAIUTE AT HOME	ONE IN HAND	IN THE NET	A PRETTY PAIUTE

EX 8

CALIFORNIA'S HERITAGE TROUT CHALLENGE

Oncorhynchus mykiss aguabonita

This year four of us from the Diablo Valley Fly Fishermen's club will be pursuing the California Heritage Trout Challenge. With the extremely wet winter and the large snow pack in the Sierra's we will be fortunate to be able to fish all the necessary waters to achieve our goal before the seasons close, but we will try!

Following below is the description of the program, its requirements and a list of fish that make up the challenge.

"Taking the California Heritage Trout Challenge"

By catching six different forms of California native trout from their historic drainages and photographing these fish you can receive a colorful, personalized certificate featuring the art of renowned fish illustrator Joseph Tomelleri. Your certificate will show six full-color images representing the trout you caught, along with their dates and locations. It is sized to fit in a standard 16 x 20 inch matted frame.

What are the requirements of the "Challenge"?

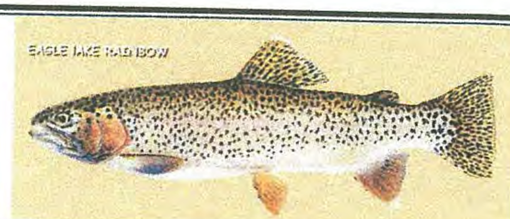
Catch six different forms of native trout from their historic drainages in California and photograph each of the trout.

Submit completed application form along with the trout photos to DFG, Fisheries Programs Branch, 1416 Ninth Street, Sacramento, CA 95814

Part of "taking the Challenge" will include learning more about the native trout of California, where they are found, and what is being done to conserve and restore these "Heritage Trout.

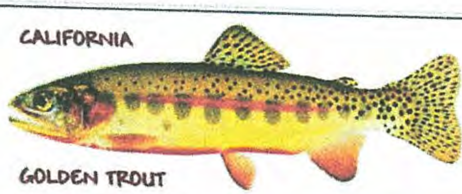
Which trout qualify for the Challenge?

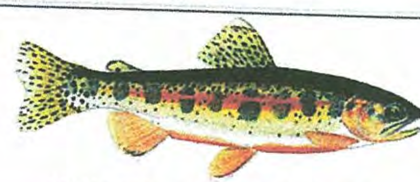
California has a large and diverse collection of trout that are native to the state's waters. The following forms are the ones that qualify:

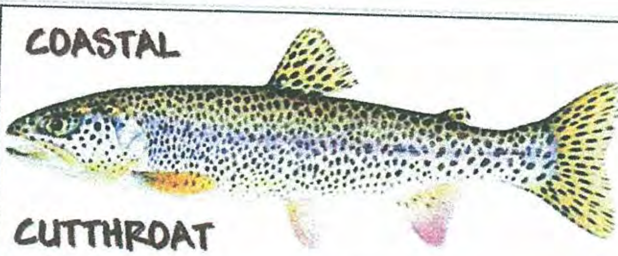


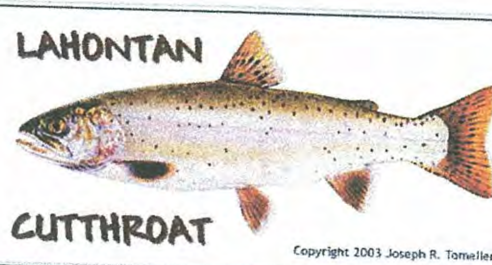
WARNER LAKES REDBAND

(No photo available)









THE PAIUTE CUTTHROAT IS NOT AVAILABLE AS IT'S ONLY HABITAT IS CURRENTLY CLOSED TO ALL FISHING.

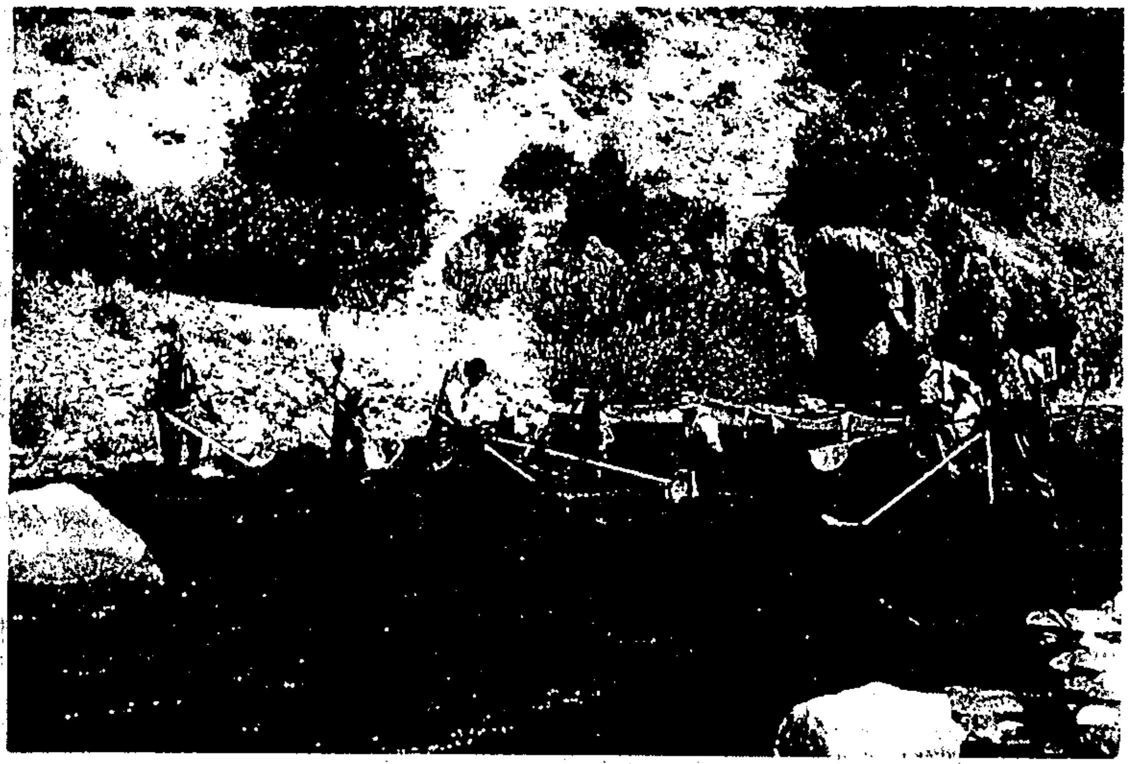
These eight forms of rainbow trout (Oncorhynchus mykiss) and three subspecies of cutthroat trout (Oncorhynchus clarki) are your targets to complete the Challenge. Catching six different forms of native trout from their historic drainages may take you to varied locations around the state. Some may be caught in roadside waters while others may only be caught in wilderness areas.

Our game plan (water conditions allowing) is as follows:

• May 24-26	McCloud River Redband	Upper McCloud River and or Trout Creek
• Various	Coastal Rainbow	Sacramento River
• July 12-14	Lahontan Cutthroat	Upper Truckee River and or Slinkard Creek
• Aug. 29-Sep. 3	Kern River Rainbow	Upper Kern River and or Salmon Creek
• Aug. 29-Sep. 3	California Golden	Trout Creek and or Fish Creek
• Aug. 29-Sep. 3	Little Kern River Golden	Clicks Creek
• Oct. 12-16	Eagle Lake Rainbow	Eagle Lake and or Pine Creek
• Oct.12-16	Goose Lake Redband	New Pine, Cottonwood, Willow, Lassen and Davis Creeks
• Oct.12-16	Warner lakes Redband	Dismal, ten and Twelve Mile Creeks
• Oct. 24-28	Coastal Cutthroat	South Fork Smith River and or Prairie, Mill and Goose Creeks

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

SURVEY OF FISH POPULATIONS IN STREAMS OF THE EAST FORK CARSON RIVER DRAINAGE, CALIFORNIA



by

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EX 9

the end of the Wolf Creek Meadows Road, provides access to some portions of the upper river. The most common route into the upper river is via U. S. Highway 395 to the north end of the Town of Walker and then west to the Little Antelope Pack Station. The start of a 7 mile trail into Soda Springs Guard Station on the upper East Fork Carson River is about 0.25 mile beyond the pack station.

The East Fork Carson River from Wolf Creek to Carson Falls was in the original group of Wild Trout Streams designated by the Commission in 1972. Four sites have been sampled in this segment, all as part of the management program associated with the Commission designation. Sections 4, 5, and 6 were originally surveyed in 1980. Repeat surveys were conducted at the Section 4 and 6 sites in 1996. Section 14 near Carson Falls was also surveyed in 1996 (Figures 2 and 32-35).

Above Carson Falls

The river above the falls is accessible by trail upstream from the Soda Springs Guard Station or by dropping down from the Pacific Crest Trail through Golden Canyon. This fairly isolated segment of the East Fork Carson River is managed as a Lahontan cutthroat refugium and is closed to angling. One monitoring site, Section 15, has been established above the falls (Figures 2 and 36).

River was officially designated a Catch-and-Release Stream by the California Fish and Game Commission in 1992.

Hangmans Bridge to Wolf Creek Two sites (Sections 2 and 3) were surveyed in this segment in 1983 and two (Sections 13 and 12) in 1994 (Figures 26-31). Total trout densities in Sections 2 and 3 differ sharply. An estimated 52 trout/mile were present in Section 2, while 2,077 trout/mile were present in Section 3 (Figure 47). Only 1% of the latter population, however, was ≥6 inches in length (Figure 48).

Section 13 had 122 trout/mile during an October 1994 survey of which 73 trout/mile were catchable-size. Total and catchable-size wild trout densities in Section 12, also sampled in 1994, were only 30 and 15 fish/mile (Figure 48).

Wild trout standing crops in the four sections between Hangmans Bridge and Wolf Creek ranged from 0.8 to 9.6 pounds/acre and averaged 5.0 pounds/acre (Figure 49).

Observations indicate that two of the sample sites between Hangmans Bridge and Wolf Creek were altered by the 1997 flood. The stream channel in Section 4 was closer to Highway 4 during the 1983 survey. During the flood the river moved across cobble bars and became established closer to the far bank (Figure 28 and 29). Section 12, which is located in a narrow steep banked portion of the stream, was severely scoured and willows growing along the far bank and on a cobble bar along the roadside bank were stripped out. Though not assessed, it appears that there were accompanying changes in streambed materials (Figures 30 and 31).

The river from Hangmans Bridge upstream to about a mile below the confluence with Wolf Creek is the only roadside reach of the East Fork Carson River within California (Figure 2). This section, paralleled by Highways 89 and 4, has long been the most heavily fished stream reach in the Markleeville area. Most of this angling is maintained by catchable-size rainbow trout plants from DFG hatcheries. Alpine County supplements this stocking program and provides variety with larger, robust trout purchased from private hatcheries. The purpose of the County's investment is to directly benefit businesses and resorts in and near Markleeville. The combined planting programs are important to the late spring through early fall economy of the area and provide recreation for many anglers who chose to visit Alpine County.

With the stocking program above Hangmans Bridge and the hike-in, trophy-trout area below, the East Fork Carson River near Markleeville provides fishing for both harvest-oriented and catch-and-release anglers. Managing the river in this manner is currently considered an appropriate and balanced use of the resource by the DFG.

Wolf Creek to Carson Falls Four sections have been sampled in this reach, all as part of the management program associated with the upper East Fork Carson River Wild Trout Stream designation. Three of these sites, Sections 4, 6, and 5, were surveyed in 1980 (California Department of Fish and Game 1979). Repeat surveys were conducted at Sections 4 and 6 in 1996. Section 14, near Carson Falls, was also surveyed in 1996 (Figures 32-35).

Trout populations in Section 4 near Bryant/Jones Creek, based on the two surveys, appeared quite stable. Total densities were estimated to be 306 and 264 trout/mile (Figure 47). Catchable-size trout densities were 191 and 200 fish/mile, and standing crops were 9.5 and 10.2 pounds/acre (Figures 48 and 49). The percent of 8-9 inch trout increased in the 1996 survey.

The species composition of the trout population in Section 6 near Poison Creek was surprisingly different during the two surveys. Brook trout, not collected during the 1980 survey or in any of the other 13 sections sampled on East Fork Carson River, comprised an estimated 913 of the 987 trout/mile in Section 6 during the 1996 survey (Figure 47). It has been assumed that these fish were washed down from Poison Creek and/or Poison Lake. Section 6 is also the site where the sculpin population increased from 8/mile in 1980 to 1,056 fish/mile in 1996. Aside from these unusual changes, catchable-size trout densities, 233 verses 183 fish/mile, and standing crops, 17.9 verses 16.1 pounds/acre were similar (Figures 48 and 49).

Section 5 in Falls Meadow, with a combined rainbow and brown trout population, had the greatest biomass on the upper river and, with 508 trout/mile $\geq$6 inches, the highest density of catchable-size trout in the California portion of the East Fork Carson River (Figures 47-49). Instream habitat included good trout cover provided by logs, vegetation, and pool depth. The exceptionally high density of catchable-size trout coincides with the abundant cover available in this section.

Few trout were present in Section 14, near Carson Falls. Of the estimated 24 fish/mile, 16 were catchable-size. The total biomass was 1.3 pounds/acre was the lowest on the upper river (Figures 47-49).

The upper East Fork Carson River was one of the original six canyon streams designated as Wild Trout waters, not due to their exceptional trout populations, but to help maintain wilderness fishing experiences known to past generations of California anglers. This remains a goal of the statewide Wild Trout Program which has since been expanded to include several other trailside waters. The management program for the upper river has centered mostly on habitat concerns. The last fish population monitoring surveys were conducted in 1996 and 2001. If resources and priorities permit the DFG should monitor trout populations in the upper river at 5 year intervals.

An angler box survey program, perhaps maintained through the cooperation of the U. S. Forest Service or the pack station in the area, could be used to monitor the fishery.

Volunteer angler survey reports are currently being used to follow trends in wild trout fisheries statewide and may identify any major changes in angling quality on the upper river (Deinstadt et al. 1993).

Above Carson Falls One fish population monitoring site, Section 15, has been established above the falls (Figure 36). Lahontan cutthroat trout, the only fish species known to be present in the drainage above falls, had an estimated population of 202 fish/mile in 1989 (Figure 47).

The upper East Fork Carson River above Carson Falls should continue to serve as a headwater refugium for Lahontan cutthroat trout. This population of Lahontan cutthroat trout is one of the few remaining composed of original Carson River strain fish. The reach above the falls is identified in the current U.S. Fish and Wildlife Service recovery plan as having a population important for recovery (U. S. Fish and Wildlife Service 1985, 1994). The closed to angling restriction currently imposed on this reach of stream continues to be the preferred means of protecting this population.

Bryant Creek Site Descriptions and Fish Populations

Bryant Creek originates at the confluence of Mountaineer and Leviathan creeks at 6,142 feet elevation and drops 1,000 feet elevation as it runs northeast for approximately 6.5 miles before flowing into the East Fork Carson River in Nevada (Figure 2).

There is an impassable fish barrier (50-foot long box culvert with a five foot exit drop into a plunge pool) 0.2 mile downstream of its origin that prevents fish passage from the lower reaches of Bryant Creek. Downstream of the box culvert Bryant Creek enters a narrow gorge that contains numerous rock falls that may or may not be fish barriers. The riparian community consists primarily of willow and mountain alder while the upland is dominated by pinyon pine and sage brush. In the lower reaches of Bryant Creek in Nevada, the fluvial floodplain is grazed by cattle and there is a water diversion that diverts the majority of the streamflow during the summer and fall. Two sites were sampled on Bryant Creek. The upper site is in a lower gradient reach about 0.1 mile upstream of the box culvert. The lower site is below the box culvert just upstream of the gorge, near the Nevada state line (Figures 50 and 51).

Trout Population and Management Implications

No fish were captured in the lower site. Four small rainbow and one catchable-size brook trout (80 fish/mile) were captured in the upper section. Trout biomass in the upper section was 2.3 pounds/acre (Figures 52-54).

Carson-Iceberg Wilderness

FEATURES

fishing • hiking • climbing • pack stations
towns and resorts • public campgrounds • history
biology • geology

Jeffrey P. Schaffer

EX 10

Acknowledgments

Foremost, I would like to thank Jim Ryan, a former associate fishery biologist with the Department of Fish and Game, for his very significant contributions to this book both in the original edition and in this new edition. With his imput, this book now has first-rate coverage of the area's trout—where they are, how they are managed, and how you catch them.

Steve Felte, General Manager of the Calaveras County Water District, answered all my questions about the North Fork Stanislaus River Hydroelectric Development Project.

Gladys Smith, an outstanding Sierra botanist with a guide to vegetation of the Lake Tahoe area, identified one perplexing, though fairly common, plant in the Carson-Iceberg Wilderness, the western mugwort.

Peter Browning gave his expertise on the origin of Sierra Nevada place names.

For the first edition the following people reviewed part or all of the manuscript: Bruce Ungari (Calaveras Ranger District), Steve Brougher and Bob Riede (Summit R.D.), Jack Carlson and Neil Botts (Carson R.D.), and Jim White (Calif. Dept. of Fish & Game).

During the summers of 1990 and '91, when I worked on the glacial history of the Stanislaus River drainage, I extracted cores from a series of lakes, ponds and bogs to determine when they came into being. Aiding me in this strenuous task were Eric Edlund, Eddie Matzger, Ken Ng and Rudy Goldstein. During this research, Greg and Stephanie Stubbs allowed me unrestricted use of their mountain home as a base camp, which made the physical hardships of my daily work far more bearable.

Hiking alone in the wilderness can be lonely and at times dangerous, and I thank those who've at times accompanied me, particularly on summit ascents: Ken Ng, Steve Rieser, John Mills and Rudy Goldstein.

Finally, this book project and my two-summer glacial research have been very stressful, as most mountain field work tends to be, and I thank my wife, Bonnie, and my daughter, Mary Anne, who endured my long absences from home.

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Photographs by the author
Topographic map (in pocket) revised and updated by the author, based on U.S. Geological Survey maps

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Title page: **The Iceberg (left) and the East Carson canyon, viewed from the summit of Stanislaus Peak**

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Part One Introductory Cha

Part Two Route Chapte

Now we make a 400-foot descent, passing a grove of large junipers and then negotiating short, steep switchbacks down to the east edge of sagebrush-covered, cattle-populated **Upper Fish Valley**. Here you can expect to find a signed trail junction near a tall snow-depth marker. To follow Silver King Trail 1017 (incorrectly signed as 1701 in 1986) up-canyon, consult Route RF-7. If **Connells Cow Camp** is your goal, head across Upper Fish Valley to the union of Bull Canyon creek with Silver King Creek. From the campsite here, Route RF-6 starts a climb up a primitive trail to Whitecliff Lake.

Most folks, however, either stay near the corrals of the camp, which is under the Forest Service, or else head down-canyon to Commissioners Camp. Heading north toward that goal, one goes about 350 yards to a meeting of three fences, each with its own gate. Go through the north gate and follow the path that parallels the west side of the north-northeast-heading fence. The trail soon starts to curve northwest, climbs over a low moraine left by a retreating glacier, and crosses bedrock slopes to get you to a sign—perhaps still standing when you get here. From the sign you can head 120 yards south to a chorusing, 20-foot-high cascade, **Llewellyn Falls.**

Llewellyn Falls is a barrier that trout cannot ascend (upstream trout occasionally go over the falls unharmed). Perhaps as a giant glacier slowly retreated up Silver King canyon, perhaps about 140,000 years ago, cutthroat trout followed its path. They would have been able to swim into Upper Fish Valley and to higher valleys *if* they did so before Silver King Creek eroded away bedrock to form the falls. Once isolated, they evolved into a subspecies called Paiute cutthroat trout (*Salmo clarki seleniris*), or simply, Paiute trout. These trout became threatened by extinction through overfishing and also through introduction of Lahontan cutthroat and rainbow above Llwellyn Falls in the 1940s and '50s through human error. Paiute cutthroat readily cross bred with Lahontans and rainbows to form hybrids. This interbreeding was noted in 1963, and in 1964 Department of Fish and Game workers removed purebreds and treated Silver King Creek with rotenone to kill the hybrids. The purebreds were then reintroduced above the falls. Their population grew from about 150 in the late 1960s to about 600 in the early 1970s. However, some hybrids were missed, so a second rotenone treatment was done in 1976. This too failed to get all the hybrids.

Llewellyn Falls

In the early 1980s the U.S. Fish and Wildlife Service prepared a recovery plan for Paiute cutthroat of the Silver King Creek drainge. The plan, endorsed by the California Department of Fish and Game (CDFG) and by Toiyabe National Forest (TNF), had three elements: 1) salvage and replanting of hybrid trout in nearby waters for angling; 2) chemical treatment with the registered pesticide rotenone of all target waters above Llewellyn Falls; and 3) replanting with adult Paiute trout from identified streams not included in items 1 and 2. Work by CDFG, TNF and Trout Unlimited began in July 1991 with capture of about 1000 hybrids. The live trout were air lifted by helicopter and released in Tamarack and Poison lakes and in the East Carson River near Soda Springs Guard Station. Later, a far more intensive rotenone treatment was performed from Llewellyn Falls all the way up to the headwaters. This will be repeated in 1992 and '93, and later, if necessary, to remove hybrids arising from chemically unscathed eggs and missed adults.

Beyond the Llewellyn Falls gorge you enter fishing country as the trail descends briefly northwest to the south end of Lower Fish Valley. It then approaches Silver King Creek and reaches a white-bordered, carbonate spring just before leaving the creekside. Not

far past the spring, the trail again
Silver King Creek and then par
about 150 yards. Then, where
meanders west, you can walk alo
edge of the meander toward **Con**
Camp, which is located near the c

RF-6 Whitecli

Distances
2.7 miles (approx.) to Whitecliff I
3.6 miles (approx.) to Whitecliff I

Trailhead Same as the Route
head

Introduction Whitecliff Lake,
miles from Rodriguez Flat, certain
of the most alpine and most isolat
the wilderness. But camping spac
lake is minimal, and the lake's
certainly lacks the forage necessa
It's doubtful that any equestrian w
ride to the lake anyway, particula
massive 1986 avalanche, which
stretch of trail virtually impassab
Backpackers are also rare, for th
trout, and fishing is prohibited
And the strenuous nature of th
courages all but the most determ
taineers. These individuals are the
souls to take this route, for th
intimidating east face of Whitecliff
countless Class 5 routes up to
Undoubtedly, virtually everyone wl
to the summit has made a much e
which is described at the end of t
at virtually every peak in the w
along its border, the summit views
the labor of the ascent.

Description After you've trekke
from Rodriguez Flat to Connells
you begin a hike upstream alon
bank of Bull Canyon creek. With
yards you should be able to fin
doned trail, and shortly thereafte
veers south. You continue in your
tion, southwest, soon climbing au
shallow, broad gully. The trail
disappears before the head of the s
maintaining a steady course
quickly find its resumption on s
Bull Canyon creek.

Now ½ mile up from the camp
firs have yielded to red firs, and

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Re: Comments: Application of Pesticides to Waters of the United States in Compliance With FIFRA (Proposed rule to eliminate National Pollution Discharge Elimination System [NPDES] Permits under the Clean Water Act for the Discharge of Aquatic Pesticides for Aquatic Weed and Pest Control in Waters of the United States). FEDERAL REGISTER February 1, 2005, page 5093.

We have reviewed the EPA information regarding elimination of NPDES permits for the discharge of aquatic pesticides. We have reviewed over the past several years many of the rotenone poisoning projects conducted or proposed by the California Department of Fish and Game (CDFG) on public land in the Sierra Nevada, CA. We have also reviewed other aquatic and terrestrial pesticide projects conducted or proposed by government agencies in the western US, including the use of antimycin to eliminate fish in other western states and the use of herbicides on public land managed by the USDA Forest Service. We are submitting these comments as private citizens in the public interest.

The EPA states that this rule is needed because "a requirement to obtain an NPDES permit could impede the ability of local officials to quickly control pests, such as mosquitoes, that may carry communicable diseases like West Nile virus or invasive species that may damage natural resources." These parameters include a vast array of situations, species, and habitats that may or may not constitute a crisis with a need to "quickly control pests." The proposed rule will all but eliminate biological/ecological review by the public and independent scientists on the merits of using pesticides in a given situation. In many cases, the conditions leading to a professed need to use pesticides have been years, often many decades, in the making and have been created by the very agencies that now propose to remedy some perceived problem by the use of poisons.

The EPA through administration of the Clean Water Act should be concerned about the overuse, unnecessary, or unwise use of poisons in the nation's streams, rivers, lakes, and nearby terrestrial areas. By eliminating the need for NPDES permits for the broad categories of projects covered in this rule, the EPA is turning its back on evaluating whether or not a project should be conducted at all.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) label in no way reviews the need for a project. Nor does it specify monitoring to determine whether or not the label instructions were followed or whether or not the pesticide behaved as expected within or beyond the project boundaries. These requirements are covered by the NPDES permit, not by FIFRA and not by the agencies proposing the project.

Further, FIFRA makes no determination of the effect of the "pesticide" on non-target, native species or on the community of organisms and the food web to be poisoned. "Pesticide" is a misnomer because many of the non-target, native species killed by regulated poisons are not "pests," and most poisons being used are not species-specific.

The definition of "pest" is made by the agency that wants to use the poison. The environmental review of pest eradication projects is required by the National Environmental Policies Act (NEPA) if the project is on federal land and, in California, by the California Environmental Quality Act (CEQA) if the project is on state land or is to be conducted by a state agency on other public land. But this system of review often fails the public because the agencies proposing the project also conduct the review.

NPDES permits allow projects to be evaluated by an independent agency (in California, Regional Water Quality Boards and the State Water Board) on a site-specific basis, at the local level and to include monitoring requirements. In California, the NPDES review assures that projects are in compliance with the Basin Plans for each regional water district. The NPDES permit review also determines whether or not a project is likely to cause harm to non-target species and whether or not the project protects beneficial uses of water.

The function of the NPDES permit on stream poisoning projects was recently acknowledged by the USDA Forest Service (Forest Service) in an Errata to a Decision Notice (DN) on an Environmental Assessment (EA) made for a proposed fish eradication project in the Carson-Iceberg Wilderness Area in the Sierra Nevada, CA. In the 2004 EA, DN and Finding of No Significant Impact (FONSI), the Forest Service, responding to public comments had claimed repeatedly and incorrectly that the project had a NPDES permit. Upon appeal, the Forest Service amended their DN and FONSI to state that the California Department of Fish and Game (CDFG) can not implement the project without a California NPDES permit (USDA Forest Service, Frederick Norbury, Appeal Deciding Officer to N.A. Erman, August 5, 2004, and Errata to DN, undated, mailed Aug. 12, 2004, Paiute cutthroat trout recovery project, Silver King Creek, Humboldt-Toiyabe National Forest, Alpine County, CA).

This EPA proposed rule makes the assumption that all proposed "missions" by "public health authorities, natural resource managers, and others who rely on pesticides" are sound, wise, and for the public good. Many are not. Nor are many emergencies, but rather long-standing problems that have been and continue to be created by the same agencies that want to use the pesticides. In many cases the pesticides can not solve the initial problem, and they cause additional problems for other species, for the community, and for the food web.

Until the responsible agencies recognize and acknowledge the underlying reasons for many of the unwanted species in the nation's waters and riparian zones, they will be unable to solve the problems with pesticides.

Non-native fish species have been and continue to be stocked by state fish and game agencies and by the US Fish and Wildlife Service. These species were/are stocked without environmental review and constitute a form of biological pollution. Perhaps the greatest threat of these stocking programs is the lesson they teach the public: it is a good idea to move fish around. For this reason and because of the continued official agency fish stocking, few fish eradication projects are successful in removing unwanted fish species over the long term (see for example, the decades-long records of poisoning streams and springs in the Golden Trout Wilderness and the Carson–Iceberg Wilderness, CA)

An attempted fish eradication project in a reservoir, Lake Davis, CA, in the mid 1990s failed to eradicate the northern pike, poisoned a water supply for the town of Portola, and cost the state $15 million, some paid in reparations to the local community (Braxton-Little, Sacramento Bee, March 1, 2005). Components of the rotenone formulation, including piperonyl butoxide, persisted in the reservoir long after the poisoning was conducted. Portola has not used water from the reservoir since that time. The pike have been thriving in the intervening years, probably partly due to elimination of predators and competitors. The reservoir had been stocked with many non-native fish, but the northern pike was an illegal stocking, that is, a species not stocked by the CDFG. It is not easy for members of the public to understand why they can not stock the fish they want, if fish and game agencies can do it.

Rotenone, the fish poison currently being used in California, is not species specific, nor is it merely a piscicide; but rather, it kills many non-target species including aquatic invertebrates and amphibians. In addition, the rotenone formulation currently used in California streams and springs is Nusyn-Noxfish, which contains other toxic cube resins, such as deguelin, and piperonyl butoxide in amounts equal to rotenone. Piperonyl butoxide is highly acutely toxic to aquatic macroinvertebrates (EPA, National Pesticide Telecommunications Network).

CDFG is now requesting rotenone projects of three years duration, with one or two applications a year, because they have had so little success in eliminating unwanted fish with one-year applications. The great majority of aquatic invertebrates have one-year life cycles. A three-year project eliminates many invertebrates from the stream and riparian area for as long as four years or longer. Many terrestrial animals are dependent on the food source of emerging stream insects and fish and are put at risk from these projects because a major part of their food supply is eliminated for several years. This cascading effect in food webs is a major ecological disturbance.

The impacts of rotenone on aquatic invertebrates are well known, have been studied for many years and continue to be studied (e.g., Almquist 1959, Binns 1967, Meadows 1973, Helfrich 1978, Engstrom-Heg et al. 1978, Chandler 1982, Dudgeon 1990, Mangum and Madrigal 1999, Cerreto et al. 2003). The impacts are variable depending on the sensitivity of each species to rotenone, the concentrations and formulations used and the frequency of use. Some species may be eliminated or greatly reduced while the resistant species increase in numbers after rotenone poisoning. Cosmopolitan or “weedy” colonizer species, relatively insensitive to rotenone, tend to replace more sensitive species and the overall species diversity decreases.

Most studies of the effects of rotenone on aquatic invertebrates have been short-term, that is, have not continued for several years after the poisoning ends. Most have only identified larval aquatic insect forms and, therefore, have not determined the number of species affected or eliminated by rotenone. If a higher taxon than a single species is affected, one can assume that a higher number of species is being affected. For example, when a study reports that a genus, family, or order has disappeared or shown major stream drift, one must assume the taxon represents more than one, and perhaps many, species.

A long-term study on a Utah river found that invertebrates did not return to pre-rotenone status even after five years (Mangum and Madrigal 1999). Up to 100% of Ephemeroptera, Plecoptera, and Trichoptera [mayflies, stoneflies and caddisflies] were missing after the second rotenone application. Forty-six percent of the taxa recovered within one year, but 21% of the taxa were still missing after five years. At least 19 species were still missing five years after the rotenone treatments. (We write "at least" because some taxa were identified only to genus and may have included more than one species).

We re-analyzed data from two CDFG monitoring studies on the impacts of rotenone on aquatic macroinvertebrates conducted in the 1990s in Silver King Creek and Silver Creek, Alpine County, CA (Trumbo et al., 2000a, 2000b). The data showed significant long-term impacts (longer than one year following final poisoning) to macroinvertebrates including decreases in species diversity, decreases in number of taxa, decreases in number of stoneflies and major reductions of the stonefly family Peltoperlidae, the most abundant stonefly group prior to the poisoning. The stonefly data were the only raw data available in the final reports of these two studies. We think that similar losses occurred in other macroinvertebrate groups.

CDFG is now proposing a new fish eradication project in the same region. In providing justification for the project, CDFG has continued to misrepresent the data from these monitoring studies. In 2003, CDFG provided the Lahontan Regional Water Quality Control Board (LRWQCB) staff misleading information when they claimed that "No evidence of long-term impacts were found in either study" (Interagency Study Proposal, LRWQCB files, June 15, 2003, Evaluation of Rotenone use in Silver King Basin on Aquatic Macroinvertebrates, 2003-2007). Our analysis of the limited data available in the reports showed otherwise.

This recent example demonstrates three key points: 1) the agency as a proponent can not be an unbiased judge of the possible impacts of its actions, 2) the CDFG agency's own data clearly demonstrated the harm of Nusyn-Noxfish (a registered pesticide used according to the label) to non-target organisms, and 3) without the step of the required NPDES permit, there would have been no opportunity for an independent body to judge the risks involved in CDFG's latest project.

Current bioassessment studies conducted by the State of California are inadequate to answer the question of what species and how many are being lost or affected by poisoning. Studies are needed specifically for each project with rigorous research design and valid controls.

Many of the stream poisoning projects now being carried out or proposed in the western US are in the most pristine and unspoiled streams and rivers of the country in designated Wilderness Areas and national parks. Many are in isolated headwater areas that have a high probability of containing other rare and endemic aquatic species, for the same reason that they have rare subspecies of fish. Research has revealed rare and/or endemic species of invertebrates in many springs and headwater reaches in the Sierra (e.g., Erman and Erman 1990, 1995) These are the sites that should be most protected.

The mountain yellow-legged frog and the Yosemite toad are both candidates for listing as endangered species and both were/are found in stream basins in the Sierra Nevada that are proposed for fish eradication or where fish eradication has been attempted for many decades. There is no time during the year that tadpoles of the mountain yellow-legged frog would not be in a stream in higher elevations because the mountain yellow-legged frog spends up to four years as a tadpole. Adult frogs are highly aquatic compared to other amphibian species (Dr. Kathleen Matthews, USDA Pacific Southwest Experiment Station 2003, High Sierra Ecosystems, Science Perspectives, USDA Pacific Southwest Experiment Station).

Based on the evidence for impacts of rotenone on non-target species in fish eradication projects, there is no reason to assume that this pesticide "will perform its intended function without unreasonable adverse effects on the environment" or that "when used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable adverse effects on the environment." To the contrary, there are many reasons to assume that rotenone and other pesticides have caused unreasonable adverse effects on aquatic species, communities and aquatic and riparian food webs for many decades. We disagree with the EPA that aquatic pesticides are not pollutants.

Furthermore, there are far too many documented incidences of rotenone not being applied consistent with relevant requirements and of unexpected outcomes resulting from its use. Most of these examples come from independent monitoring by water quality control boards. Following are several examples from California agency files and published reports of problems identified by monitoring fish eradication projects:

- Use of rotenone as a stream poison requires that rotenone must be neutralized chemically in order to control its toxic effect downstream from treatment areas. This chemical neutralization is commonly attempted with potassium permanganate. Failure by the California Department of Fish and Game (CDFG) to achieve complete neutralization and, thereby, to cause fish kills from the potassium permanganate is documented in California Regional Water Quality Control Board files.
- During rotenone poisoning of Silver King Creek, Mono County, 1992, approximately 1000 fish were killed downstream of the project area from the application of potassium permanganate (Lahontan RWQCB files). The following year, 1993, during a repeat poisoning of the same area, detoxification of the rotenone was chemically incomplete (Flint et al. 1998). The record shows that CDFG has difficulty managing the performance of potassium permanganate and detoxifying the rotenone.
- In the Lahontan Region alone, 6 of 11 rotenone projects between 1988 and 1994 violated water quality standards. Rotenone, rotenolone, or naphthalene were detected downstream or persisted longer than limits established in Basin Plans (Lahontan RWQCB files).
- During application of rotenone in Silver Creek, Mono County, in 1994, independent testing by the Regional Water Quality Control Board found carcinogenic compounds in water. In contrast, testing by CDFG at the same sites found no detectable carcinogenic compounds (Lahontan RWQCB files).
- Rotenone was detected in sediment during a CDFG project in Silver Creek, Sept. 20, 1995. CDFG was well over their target application rate of rotenone, with data apparently missing at a critical period (Lahontan RWQCB files).

- Rotenone and its breakdown products have persisted in water for long periods after CDFG poisoning projects (Lahontan RWQCB files).
- Higher amounts of rotenone are being used than are recommended because of accidents (e.g., Flint et al. 1998).
- Reporting to RWQCBs from CDFG has not been timely. The Flint et al. 1998 Administrative Report, for example, was not submitted until 5 years after the project was completed.

Had there been no oversight by a Regional Water Quality Control Board as part of an NPDES permit most of these unintended impacts would have gone undocumented.

Recent studies have shown a possible connection between rotenone and Parkinson's disease and are instructive in considering pesticides. We do not yet know all the implications of recent scientific findings. Knowledge of the complex interactions of pesticides is always incomplete. Through time, as knowledge improves, many pesticides are eventually withdrawn from use. But regulatory approval (or withdrawal) is a slow process and often lags far behind scientific findings. We note, for example, that with respect to rotenone the last full EPA updated review was in the 1980s. A planned update was expected first in 2003 or early 2004. The EPA web site now states an expected update is planned for May 2006. (The EPA also conducted a comprehensive review in 1997 of available testing data on chemical hazards for high production volume chemicals. Rotenone was not included in the EPA's survey of testing data. We do not know if rotenone, in all its various pesticide formulations, did not constitute a "high production volume chemical" or if data were not available.)

The information on possible human effects of rotenone based on animal studies is unclear. The California Environmental Protection Agency, Department of Pesticide Regulation, Medical Toxicology Branch has conduced reviews and prepared a summary of toxicology data gaps for rotenone (see CAL EPA web site). The latest update is indicated as 2/18/97. For the eleven categories of toxicity, one (neurotoxicity) was "not required at this time". For the remaining ten categories, all were judged "Data gap, inadequate studies." However, for these ten categories, three had "no adverse effect indicated" and seven had "possible adverse effect indicated" in the summary.

In the specific case of rotenone used as a fish poison, currently approved formulations also include other non-rotenone cube resins. As recent research has found, deguelin, a key ingredient of "other cube resins," has most of the properties of rotenone including induction of Parkinson's disease-like syndrome in rats (Caboni et al. 2004).

The EPA web site makes a brief reference to the Betarbet et al. 2000 study on the link between Parkinson's and rotenone as if this paper represents the sum of expanding knowledge. A March 2005 search through the Web of Science for studies linking rotenone and Parkinson's disease, however, now lists 149 relevant articles with many published since 2000.

A similar lag in regulatory change may be found with respect to the effects of the herbicide atrazine on frog reproduction. Those with vested interests in maintaining the registration of atrazine will delay and complicate change at the agency level. Meanwhile, the herbicide will continue to be used as provided by registration and labeling. A recent thorough review of studies on the effects of atrazine on frogs has been published (Hayes, T.B. 2004).

Preparation of an NPDES permit allows local officials and the public to weigh the evidence of more up-to-date information and judge the present risk of a specific pesticide application to the environment, despite what may be out-of-date EPA approval, registration or labeling for a product.

In conclusion, we think the EPA would be abnegating its responsibility to the environment and to public health if it eliminates NPDES permits for many uses of aquatic pesticides or terrestrial pesticides that reach water bodies. The NPDES review process is at present the only independent, site specific analysis being made for application of aquatic poisons. The FIFRA label does not substitute for detailed review of whether or not a project is necessary or useful. A NPDES permit and FIFRA requirements are non-overlapping regulatory procedures that in no way substitute for each other. Whether label instructions are followed or not, a poison put in a water body is a pollutant and should be evaluated as such.

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California Fish and Game 90(3):101-118 2004

CONSERVATION OF PAIUTE CUTTHROAT TROUT: THE GENETIC LEGACY OF POPULATION TRANSPLANTS IN AN ENDEMIC CALIFORNIA SALMONID

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Paiute cutthroat trout, *Oncorhynchus clarki seleniris*, are threatened by loss of genetic diversity, restricted distributions, and historical hybridization with other introduced trout species. In this study, we used a single copy nuclear (scnDNA) marker and several nuclear microsatellites to assess levels of rainbow trout (RT) hybridization, estimate existing amounts of genetic variation, and characterize relationships among nine populations of Paiute cutthroat trout (PCT). No evidence of RT introgression was found in any of the PCT populations based on an scnDNA marker and five microsatellite loci. The two polymorphic microsatellite markers revealed population heterozygosities ranging from 0.138-0.657 (average=0.469) and 0.336-0.722 (average=0.544), respectively. Allele frequency distributions differed significantly from Hardy-Weinberg equilibrium in a single sample at one locus. Log-likelihood *G* tests and population pairwise F_{ST} estimates indicated significant differentiation among most of the samples, and a neighbor-joing phenogram of D_{CE} genetic distances revealed genetic relationships among populations that closely reflected PCT stocking history. Results support that efforts to eradicate hybridized PCT have been successful. However, the remaining populations are fragmented with limited genetic variation.

INTRODUCTION

The Paiute cutthroat trout, *Oncorhynchus clarki seleniris*, is a narrowly distributed form of cutthroat trout most closely related to the more widespread Lahontan cutthroat, *O. c. henshawi*, of eastern California, Nevada, and southern Oregon (Nielsen and Sage 2002). Historically, Paiute cutthroat trout (PCT) were probably restricted to an approximately 10-km stretch of Silver King Creek below Llewellyn Falls and above Silver King Canyon gorge (Fig. 1), which effectively isolated them from Lahontan cutthroat trout (LCT) inhabiting the adjacent East Fork Carson River. Over time, PCT evolved distinct phenotypic characteristics, including an almost complete lack of body spotting and an iridescent hue, which distinguished them from other cutthroat and rainbow trout (RT) populations. Snyder (1933, 1934) first recognized PCT as a subspecies based on

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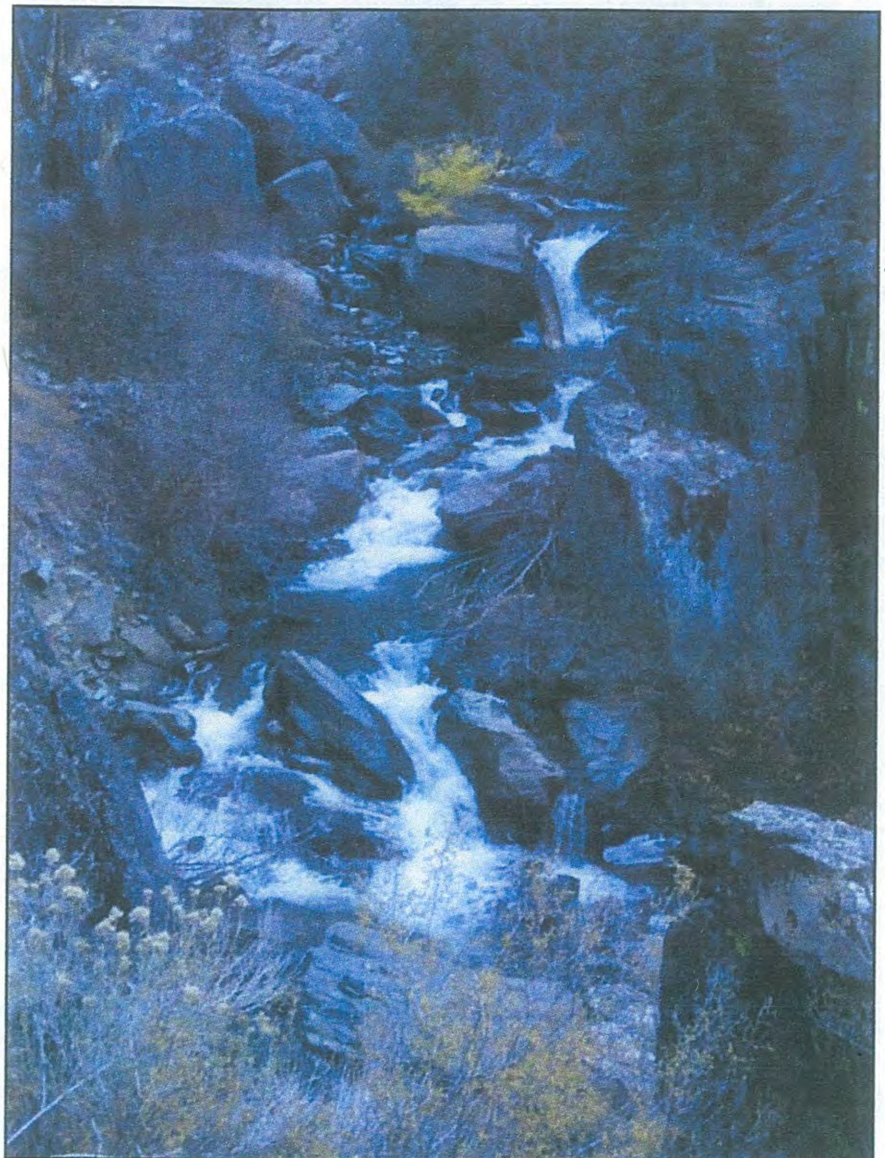
EXHIBIT 10

Table 2. Characteristics of 7 microsatellite loci evaluated for use in this study. Size ranges are given in base pairs (bp). All microsatellite primer sets are from Rexroad et al. (2001).

Microsatellite Loci	Paiute Cutthroat Trout # alleles	Paiute Cutthroat Trout Size range	Lahontan Cutthroat Trout # alleles	Lahontan Cutthroat Trout Size range	Rainbow Trout # alleles	Rainbow Trout Size range
OMM 1050	1	220	4	224-236	8	240-280
OMM 1051	1	428	5	400-496	7	232-276
OMM 1058	4	216-228	3	208-216	7	184-240
OMM 1086	1	194	3	194-202	5	194-242
OMM 1088	6	204-224	5	144-240	5	120-140
OMM 1104	1	224	1	240	5	168-216
OMM 1108	1	156	6	144-176	4	148-188

50 mM $MgCl_2$, 0.05 μl Taq I polymerase (0.25 U total), 0.2 μl of 1 mM labeled forward primer, 0.4 μ of 10 mM reverse primer, and 2 μl PCT sample DNA (approximately 10 ng total). PCR amplification conditions were the same as described above. Alleles were separated electrophoretically on a 5.5% polyacrylamide gel using the MJ Research BaseStation gel analysis system (MJ Research, Inc., Boston, Ma, USA) and analyzed using MJ Research's Cartographer software. The Genescan 500 size standard (MJ Research) labeled with ROX fluorescent dye was run in each lane.

An anonymous single copy nuclear (ascnDNA) marker was developed following protocols established in the Genomic Variation Laboratory at the University of California, Davis (Tranah et al. 2003). Briefly, 200 ng of DNA from RT, LCT, and PCT samples were digested for 1 hour at 37 °C with the restriction enzymes EcoRI and Mse I using 0.1 μl of each enzyme, 2.0 μl 10X buffer, 0.16 μl 400X BSA, and ddH_2O to 16 μl. Adapters to Mse I and EcoRI restriction sites were then ligated to the ends of the DNA fragments by adding 0.4 μl Eco Adapter (5 pmoles), 0.4 μl Mse Adapter (50 pmoles), 0.2 μl 100mM ATP, 0.2 μl T4 DNA Ligase, 0.4 μl 10x buffer, 0.1 μl 400X BSA, and 2.3 ml H_2O to the 16 ml reaction. The ligation reaction was performed overnight at room temperature, after which 180 μl TLE was added. The adapters were designed to have a final 3' nucleotide that was different from the original sequence, thus destroying the original restriction site. The fragments were then amplified via PCR using primers complimentary to the adapter sequences. The primers used were designed with one to three varying nucleotides overhanging the 3' end of the adapters. Fragments were selectively amplified by varying the specific primers that were used. Fragments were first amplified using shorter, less specific preamp primers. The PCR conditions were: 94°C for 1.5 minutes, followed by 94°C for 30 seconds, 56°C for 30 seconds, and 72°C for 1 minute for 23 cycles; 180 μl of TLE were added to the preamp PCR product for each sample. Fragments were then amplified with different combinations of the specific primers, using a touchdown PCR program with a denaturing step of 94°C for 30 seconds, an annealing step beginning at 65°C for the first cycle and decreasing 0.7°C each cycle until 56°C for 30 seconds, and an elongation step of 72°C for 1 minute. Thirty-five cycles



Site 6a: Silver King Creek, Carson Ranger District. Upstream photo of the waterfall at Site 6 and the steep canyon downstream of the barrier.

EXHIBIT 11

The Ecological Angler
ECOANGLER.COM

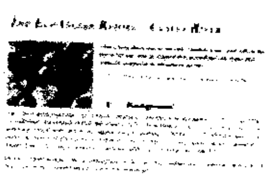
HOME FLY PATTERNS HABITAT SPECIES REVIEWS ABOUT

East Fork - Carson River

CARSON FLY PATTERNS
MAP OF AREA
FLOW INFORMATION
REGULATIONS

The *EcoAngler* Report

Planning a trip to the East Fork Carson River? Get scientific based angling intel in **The EcoAngler Report - East Fork Carson River**.



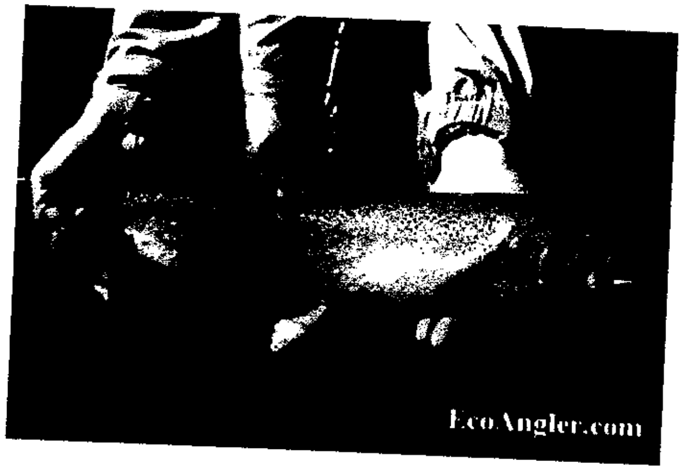
Detailed information on the East Fork Carson's native and wild trout populations along

East Fork Carson River - Hangman's Bridge to Nevada Stateline

The Carson River basin encompasses almost 4,000 square miles in California and Nevada. The Carson basin is south of Lake Tahoe and north of the Walker River. The Carson's headwaters are in the Sierra Nevada and flow eastward to drain into the marshes of the Stillwater National Wildlife Refuge. Eventually the water terminates into the Carson Sink. Roughly eighty-five percent of the watershed lands are in Nevada. However, some of the prime trout water is located near the headwaters in California.

EXHIBIT 12

available along Highway 89.



In my recent trips to the East Fork I have not netted a single brown trout. (Today fish plants continue to happen upstream of Hangman's bridge and below the confluence with Wolf Creek). Over the years, the hold overs from the earlier plants have grown nicely with several rainbows holding in larger pools over 20 inches.

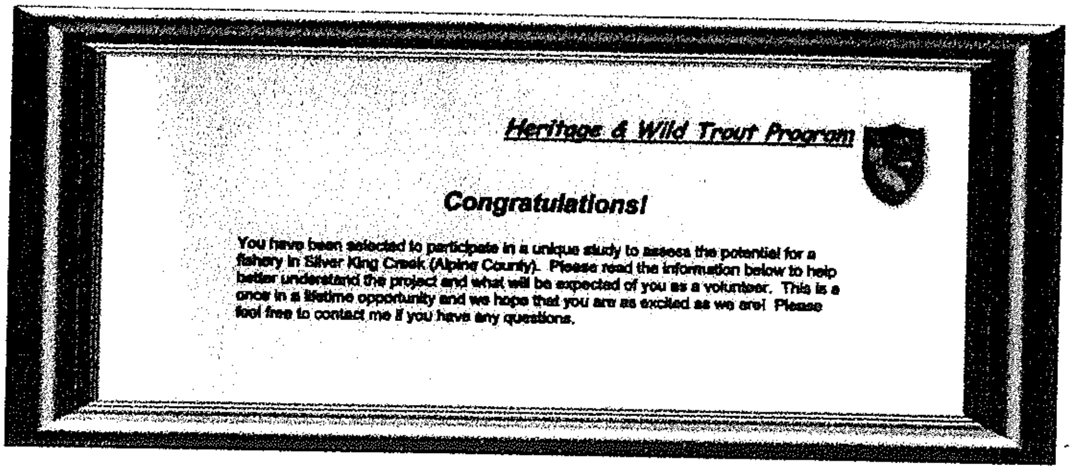
WILD AND SCENIC - THE EAST FORK

A portion of the east fork, from the town of Markleeville downstream to the state line, is included in California's wild and scenic river system. Some of the upper segments (e.g., below Hangman's bridge) are designated as wild-trout waters and special regulations apply. Please refer to California DFG's Regulations for further details. As with other high elevation streams, it's important to know the current and prior flows when fishing the East Fork of the Carson River.

SILVER KING CREEK

A RARE OPPORTUNITY TO FISH A CREEK THAT HAS BEEN CLOSED FOR OVER FORTY YEARS!

IT STARTED WITH THIS INVITATION FROM ROGER BLOOM, SENIOR FISHERIES BIOLOGIST, CALIFORNIA DEPARTMENT OF FISH AND GAME.



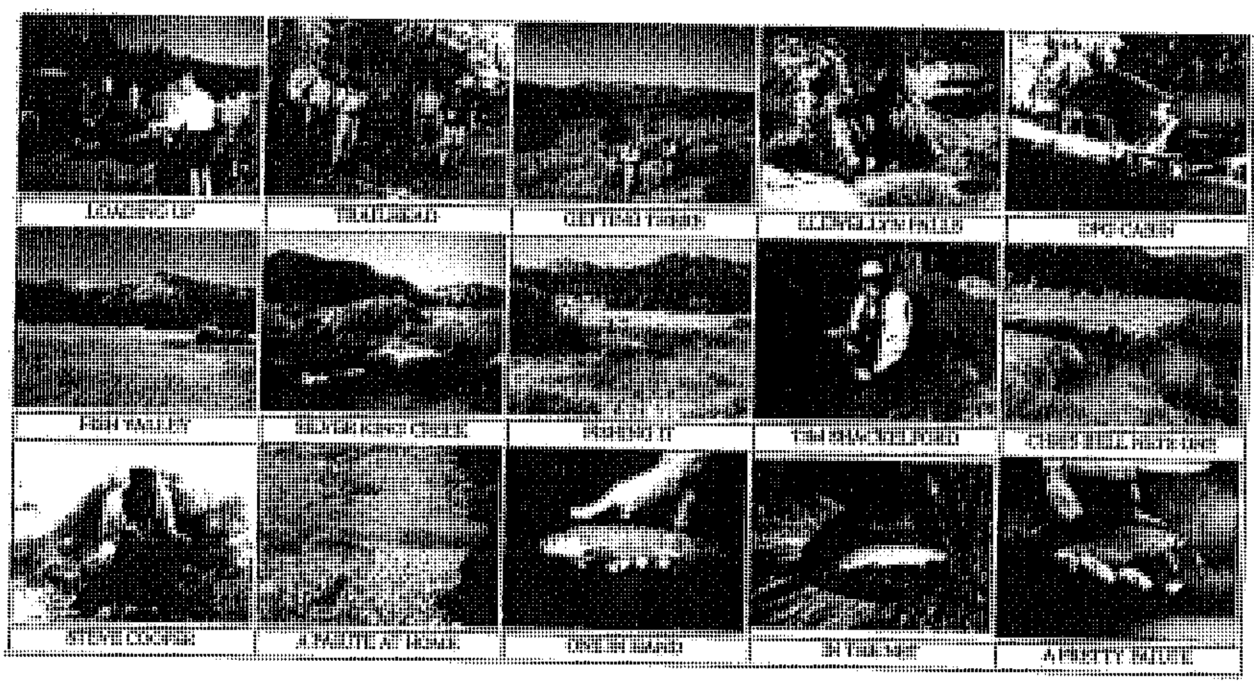
Heritage & Wild Trout Program

Congratulations!

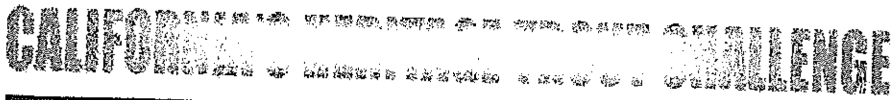
You have been selected to participate in a unique study to assess the potential for a fishery in Silver King Creek (Alpine County). Please read the information below to help better understand the project and what will be expected of you as a volunteer. This is a once in a lifetime opportunity and we hope that you are as excited as we are! Please feel free to contact me if you have any questions.

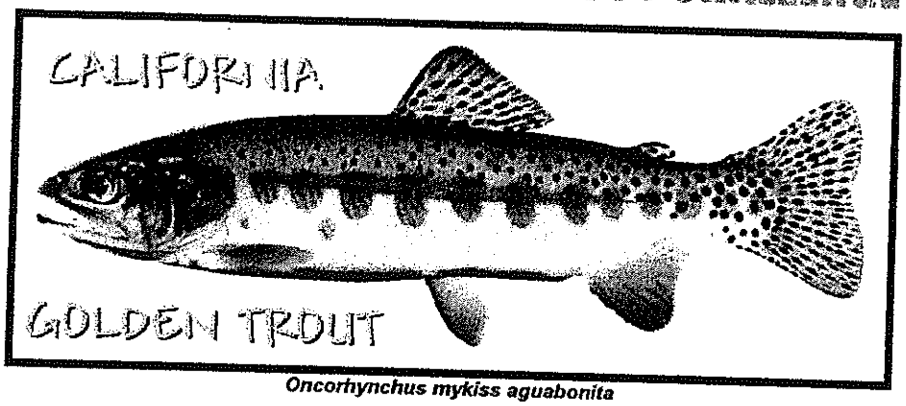
EXCITED, YOU BET I WAS! HAVING THE CHANCE TO FISH THIS CLOSED WATER AS PART OF THE DFG STUDY, ALSO WOULD ENABLE ME TO CATCH A PAIUTE CUTTHROAT THE RAREST CALIFORNIA HERITAGE TROUT AND WOULD GIVE ME TEN OF THE ELEVEN SUB-SPECIES. I COULD NOT PASS UP THIS UNBELIEVABLE OPPORTUNITY!

FOR MORE INFORMATION ON THIS STUDY AND CALIFORNIA'S HERITAGE TROUT, USE THIS LINK HTC



EXHIBT 13





Oncorhynchus mykiss aguabonita

This year four of us from the Diablo Valley Fly Fishermen's club will be pursuing the California Heritage Trout Challenge. With the extremely wet winter and the large snow pack in the Sierra's we will be fortunate to be able to fish all the necessary waters to achieve our goal before the seasons close, but we will try!

Following below is the description of the program, its requirements and a list of fish that make up the challenge.

"Taking the California Heritage Trout Challenge"

By catching six different forms of California native trout from their historic drainages and photographing these fish you can receive a colorful, personalized certificate featuring the art of renowned fish illustrator Joseph Tomelleri. Your certificate will show six full-color images representing the trout you caught, along with their dates and locations. It is sized to fit in a standard 16 x 20 inch matted frame.

What are the requirements of the "Challenge"?

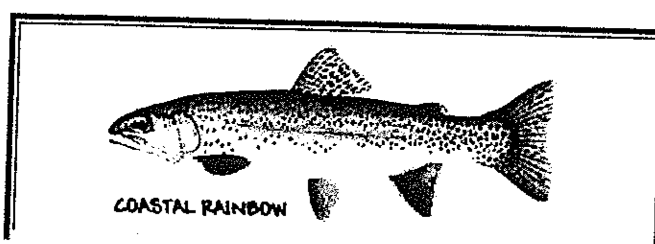
Catch six different forms of native trout from their historic drainages in California and photograph each of the trout.

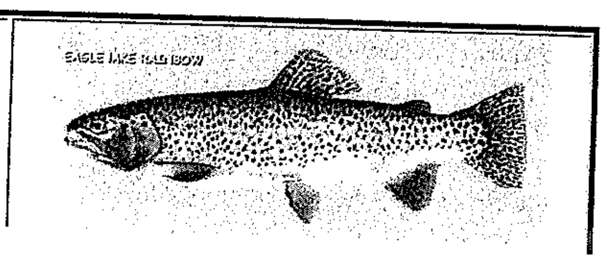
Submit completed application form along with the trout photos to DFG, Fisheries Programs Branch, 1416 Ninth Street, Sacramento, CA 95814

Part of "taking the Challenge" will include learning more about the native trout of California, where they are found, and what is being done to conserve and restore these "Heritage Trout.

Which trout qualify for the Challenge?

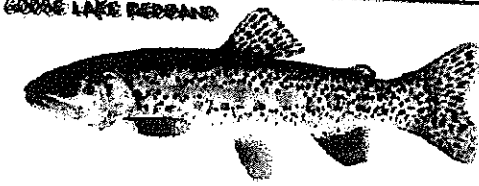
California has a large and diverse collection of trout that are native to the state's waters. The following forms are the ones that qualify:





McCloud River Redband

GOOSE LAKE REDBAND

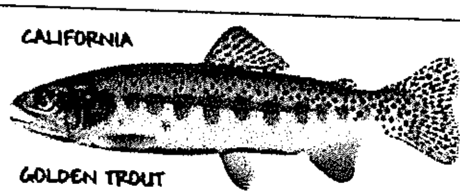


WARNER LAKES REDBAND

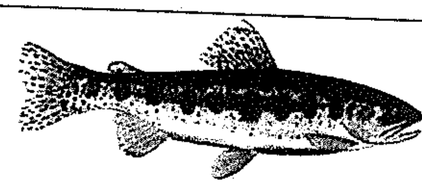
(No photo available)

KERN RIVER RAINBOW

CALIFORNIA

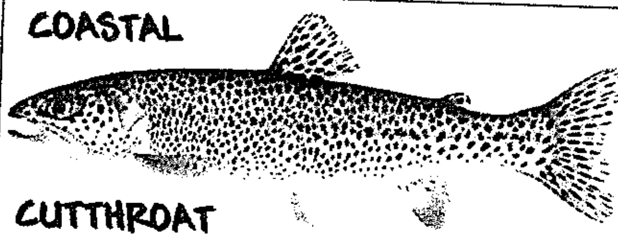


GOLDEN TROUT



LITTLE KERN RIVER GOLDEN TROUT

COASTAL



CUTTHROAT

LAHONTAN

CUTTHROAT

PAIUTE CUTTHROAT

THE PAIUTE CUTTHROAT IS NOT AVAILABLE AS IT'S ONLY HABITAT IS CURRENTLY CLOSED TO ALL FISHING.

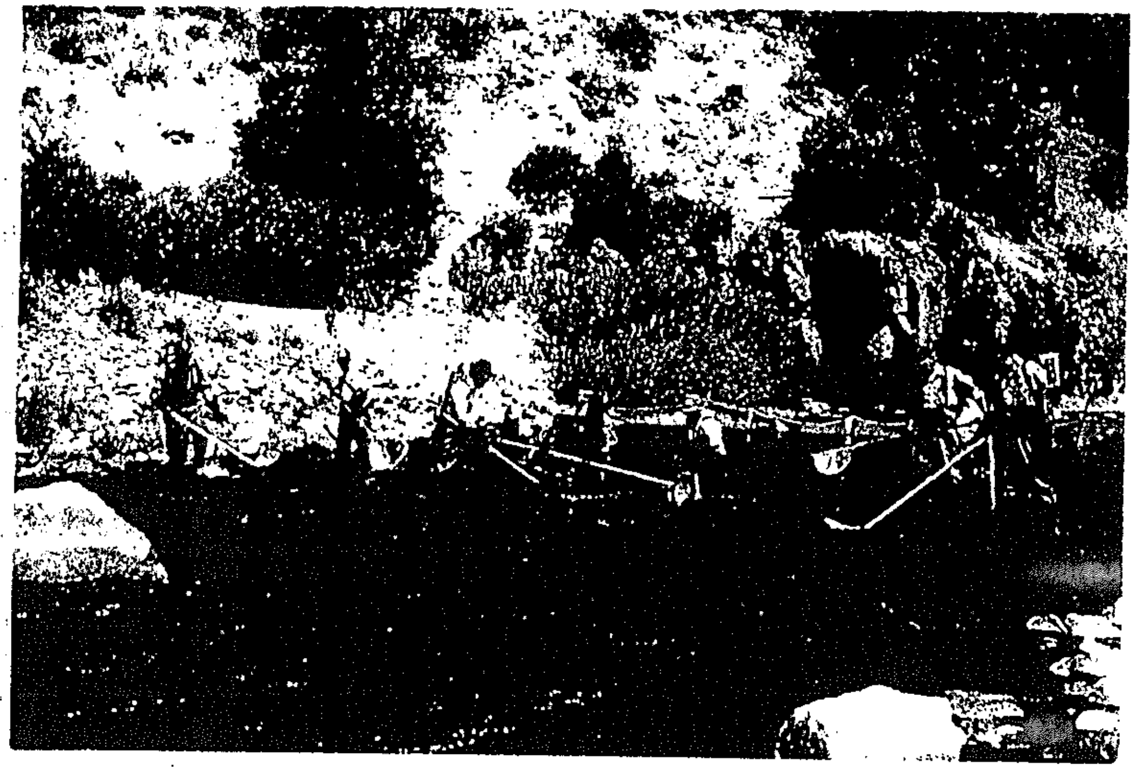
These eight forms of rainbow trout (Oncorhynchus mykiss) and three subspecies of cutthroat trout (Oncorhynchus clarki) are your targets to complete the Challenge. Catching six different forms of native trout from their historic drainages may take you to varied locations around the state. Some may be caught in roadside waters while others may only be caught in wilderness areas.

Our game plan (water conditions allowing) is as follows:

• May 24-26	McCloud River Redband	Upper McCloud River and or Trout Creek
• Various	Coastal Rainbow	Sacramento River
• July 12-14	Lahontan Cutthroat	Upper Truckee River and or Slinkard Creek
• Aug. 29-Sep. 3	Kern River Rainbow	Upper Kern River and or Salmon Creek
• Aug. 29-Sep. 3	California Golden	Trout Creek and or Fish Creek
• Aug. 29-Sep. 3	Little Kern River Golden	Clicks Creek
• Oct. 12-16	Eagle Lake Rainbow	Eagle Lake and or Pine Creek
• Oct.12-16	Goose Lake Redband	New Pine, Cottonwood, Willow, Lassen and Davis Creeks
• Oct.12-16	Warner lakes Redband	Dismal, ten and Twelve Mile Creeks
• Oct. 24-28	Coastal Cutthroat	South Fork Smith River and or Prairie, Mill and Goose Creeks

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

SURVEY OF FISH POPULATIONS IN STREAMS OF THE EAST FORK CARSON RIVER DRAINAGE, CALIFORNIA



by

John M. Deinstadt, David C. Lentz, Eric Gerstung,
and Donald E. Burton
Fisheries Programs Branch,
Roger Bloom
Habitat Conservation Planning Branch,
William L. Somer and Stafford K. Lehr
Sacramento Valley and Central Sierra Region
And
Russell Wickwire, Retired

Fisheries Programs Branch
Administrative Report No. 2004 - 8
2004

EXHIBIT 14

the end of the Wolf Creek Meadows Road, provides access to some portions of the upper river. The most common route into the upper river is via U. S. Highway 395 to the north end of the Town of Walker and then west to the Little Antelope Pack Station. The start of a 7 mile trail into Soda Springs Guard Station on the upper East Fork Carson River is about 0.25 mile beyond the pack station.

The East Fork Carson River from Wolf Creek to Carson Falls was in the original group of Wild Trout Streams designated by the Commission in 1972. Four sites have been sampled in this segment, all as part of the management program associated with the Commission designation. Sections 4, 5, and 6 were originally surveyed in 1980. Repeat surveys were conducted at the Section 4 and 6 sites in 1996. Section 14 near Carson Falls was also surveyed in 1996 (Figures 2 and 32-35).

Above Carson Falls

The river above the falls is accessible by trail upstream from the Soda Springs Guard Station or by dropping down from the Pacific Crest Trail through Golden Canyon. This fairly isolated segment of the East Fork Carson River is managed as a Lahontan cutthroat refugium and is closed to angling. One monitoring site, Section 15, has been established above the falls (Figures 2 and 36).

River was officially designated a Catch-and-Release Stream by the California Fish and Game Commission in 1992.

<u>Hangmans Bridge to Wolf Creek</u> Two sites (Sections 2 and 3) were surveyed in this segment in 1983 and two (Sections 13 and 12) in 1994 (Figures 26-31). Total trout densities in Sections 2 and 3 differ sharply. An estimated 52 trout/mile were present in Section 2, while 2,077 trout/mile were present in Section 3 (Figure 47). Only 1% of the latter population, however, was ≥6 inches in length (Figure 48).

Section 13 had 122 trout/mile during an October 1994 survey of which 73 trout/mile were catchable-size. Total and catchable-size wild trout densities in Section 12, also sampled in 1994, were only 30 and 15 fish/mile (Figure 48).

Wild trout standing crops in the four sections between Hangmans Bridge and Wolf Creek ranged from 0.8 to 9.6 pounds/acre and averaged 5.0 pounds/acre (Figure 49).

Observations indicate that two of the sample sites between Hangmans Bridge and Wolf Creek were altered by the 1997 flood. The stream channel in Section 4 was closer to Highway 4 during the 1983 survey. During the flood the river moved across cobble bars and became established closer to the far bank (Figure 28 and 29). Section 12, which is located in a narrow steep banked portion of the stream, was severely scoured and willows growing along the far bank and on a cobble bar along the roadside bank were stripped out. Though not assessed, it appears that there were accompanying changes in streambed materials (Figures 30 and 31).

The river from Hangmans Bridge upstream to about a mile below the confluence with Wolf Creek is the only roadside reach of the East Fork Carson River within California (Figure 2). This section, paralleled by Highways 89 and 4, has long been the most heavily fished stream reach in the Markleeville area. Most of this angling is maintained by catchable-size rainbow trout plants from DFG hatcheries. Alpine County supplements this stocking program and provides variety with larger, robust trout purchased from private hatcheries. The purpose of the County's investment is to directly benefit businesses and resorts in and near Markleeville. The combined planting programs are important to the late spring through early fall economy of the area and provide recreation for many anglers who chose to visit Alpine County.

With the stocking program above Hangmans Bridge and the hike-in, trophy-trout area below, the East Fork Carson River near Markleeville provides fishing for both harvest-oriented and catch-and-release anglers. Managing the river in this manner is currently considered an appropriate and balanced use of the resource by the DFG.

<u>Wolf Creek to Carson Falls</u> Four sections have been sampled in this reach, all as part of the management program associated with the upper East Fork Carson River Wild Trout Stream designation. Three of these sites, Sections 4, 6, and 5, were surveyed in 1980 (California Department of Fish and Game 1979). Repeat surveys were conducted at Sections 4 and 6 in 1996. Section 14, near Carson Falls, was also surveyed in 1996 (Figures 32-35).

Trout populations in Section 4 near Bryant/Jones Creek, based on the two surveys, appeared quite stable. Total densities were estimated to be 306 and 264 trout/mile (Figure 47). Catchable-size trout densities were 191 and 200 fish/mile, and standing crops were 9.5 and 10.2 pounds/acre (Figures 48 and 49). The percent of 8-9 inch trout increased in the 1996 survey.

The species composition of the trout population in Section 6 near Poison Creek was surprisingly different during the two surveys. Brook trout, not collected during the 1980 survey or in any of the other 13 sections sampled on East Fork Carson River, comprised an estimated 913 of the 987 trout/mile in Section 6 during the 1996 survey (Figure 47). It has been assumed that these fish were washed down from Poison Creek and/or Poison Lake. Section 6 is also the site where the sculpin population increased from 8/mile in 1980 to 1,056 fish/mile in 1996. Aside from these unusual changes, catchable-size trout densities, 233 verses 183 fish/mile, and standing crops, 17.9 verses 16.1 pounds/acre were similar (Figures 48 and 49).

Section 5 in Falls Meadow, with a combined rainbow and brown trout population, had the greatest biomass on the upper river and, with 508 trout/mile ≥6 inches, the highest density of catchable-size trout in the California portion of the East Fork Carson River (Figures 47-49). Instream habitat included good trout cover provided by logs, vegetation, and pool depth. The exceptionally high density of catchable-size trout coincides with the abundant cover available in this section.

Few trout were present in Section 14, near Carson Falls. Of the estimated 24 fish/mile, 16 were catchable-size. The total biomass was 1.3 pounds/acre was the lowest on the upper river (Figures 47-49).

The upper East Fork Carson River was one of the original six canyon streams designated as Wild Trout waters, not due to their exceptional trout populations, but to help maintain wilderness fishing experiences known to past generations of California anglers. This remains a goal of the statewide Wild Trout Program which has since been expanded to include several other trailside waters. The management program for the upper river has centered mostly on habitat concerns. The last fish population monitoring surveys were conducted in 1996 and 2001. If resources and priorities permit the DFG should monitor trout populations in the upper river at 5 year intervals.

An angler box survey program, perhaps maintained through the cooperation of the U. S. Forest Service or the pack station in the area, could be used to monitor the fishery.

Volunteer angler survey reports are currently being used to follow trends in wild trout fisheries statewide and may identify any major changes in angling quality on the upper river (Deinstadt et al. 1993).

Above Carson Falls One fish population monitoring site, Section 15, has been established above the falls (Figure 36). Lahontan cutthroat trout, the only fish species known to be present in the drainage above falls, had an estimated population of 202 fish/mile in 1989 (Figure 47).

The upper East Fork Carson River above Carson Falls should continue to serve as a headwater refugium for Lahontan cutthroat trout. This population of Lahontan cutthroat trout is one of the few remaining composed of original Carson River strain fish. The reach above the falls is identified in the current U.S. Fish and Wildlife Service recovery plan as having a population important for recovery (U. S. Fish and Wildlife Service 1985, 1994). The closed to angling restriction currently imposed on this reach of stream continues to be the preferred means of protecting this population.

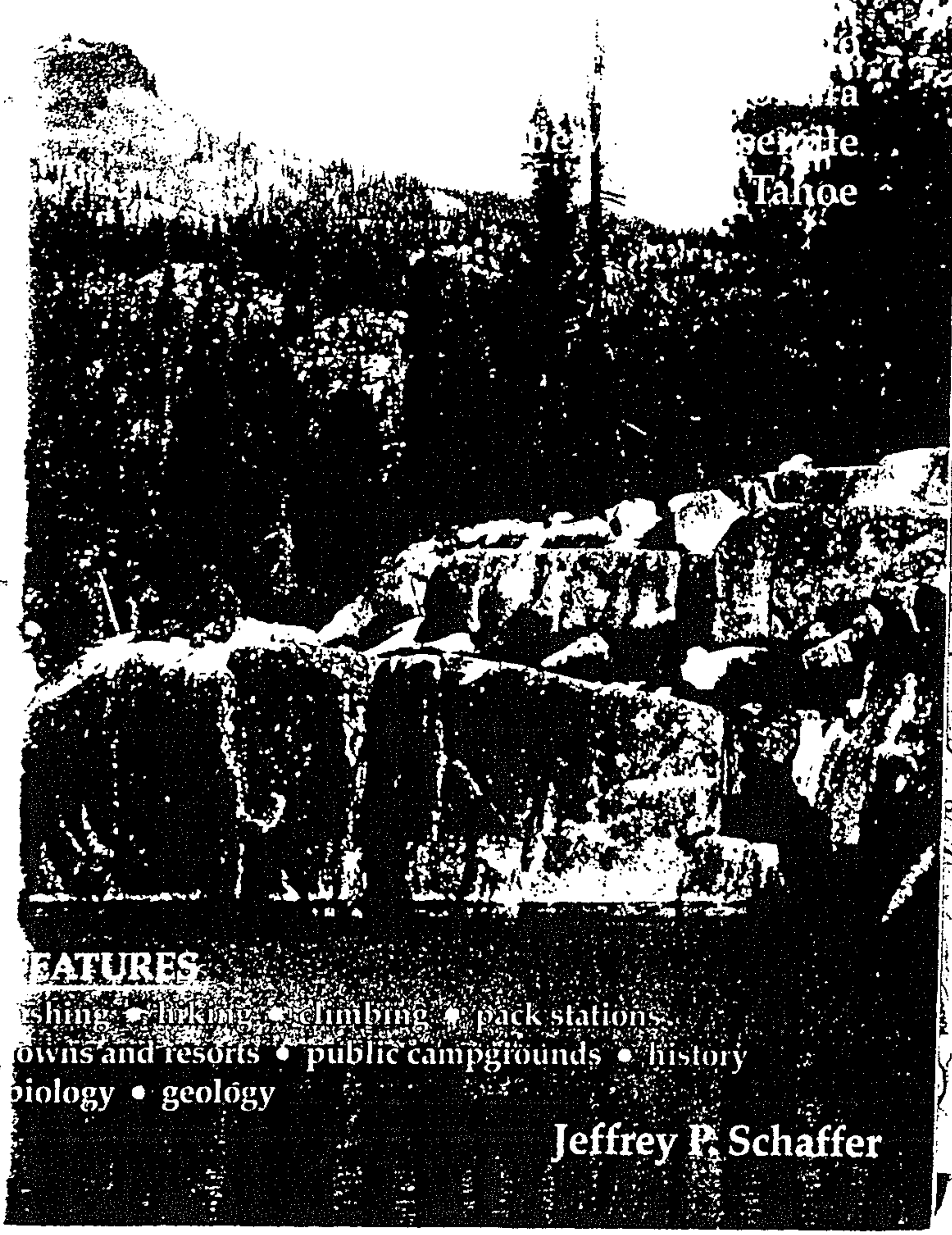
Bryant Creek Site Descriptions and Fish Populations

Bryant Creek originates at the confluence of Mountaineer and Leviathan creeks at 6,142 feet elevation and drops 1,000 feet elevation as it runs northeast for approximately 6.5 miles before flowing into the East Fork Carson River in Nevada (Figure 2).

There is an impassable fish barrier (50-foot long box culvert with a five foot exit drop into a plunge pool) 0.2 mile downstream of its origin that prevents fish passage from the lower reaches of Bryant Creek. Downstream of the box culvert Bryant Creek enters a narrow gorge that contains numerous rock falls that may or may not be fish barriers. The riparian community consists primarily of willow and mountain alder while the upland is dominated by pinyon pine and sage brush. In the lower reaches of Bryant Creek in Nevada, the fluvial floodplain is grazed by cattle and there is a water diversion that diverts the majority of the streamflow during the summer and fall. Two sites were sampled on Bryant Creek. The upper site is in a lower gradient reach about 0.1 mile upstream of the box culvert. The lower site is below the box culvert just upstream of the gorge, near the Nevada state line (Figures 50 and 51).

Trout Population and Management Implications
No fish were captured in the lower site. Four small rainbow and one catchable-size brook trout (80 fish/mile) were captured in the upper section. Trout biomass in the upper section was 2.3 pounds/acre (Figures 52-54).

arson-Iceberg Wilderness



a
be... emite
Tahoe

EATURES

shing • hiking • climbing • pack stations
owns and resorts • public campgrounds • history
biology • geology

Jeffrey P. Schaffer

EXHIBIT 15

Acknowledgments

Foremost, I would like to thank Jim Ryan, a former associate fishery biologist with the Department of Fish and Game, for his very significant contributions to this book both in the original edition and in this new edition. With his imput, this book now has first-rate coverage of the area's trout—where they are, how they are managed, and how you catch them.

Steve Felte, General Manager of the Calaveras County Water District, answered all my questions about the North Fork Stanislaus River Hydroelectric Development Project.

Gladys Smith, an outstanding Sierra botanist with a guide to vegetation of the Lake Tahoe area, identified one perplexing, though fairly common, plant in the Carson-Iceberg Wilderness, the western mugwort.

Peter Browning gave his expertise on the origin of Sierra Nevada place names.

For the first edition the following people reviewed part or all of the manuscript: Bruce Ungari (Calaveras Ranger District), Steve Brougher and Bob Riede (Summit R.D.), Jack Carlson and Neil Botts (Carson R.D.), and Jim White (Calif. Dept. of Fish & Game).

During the summers of 1990 and '91, when I worked on the glacial history of the Stanislaus River drainage, I extracted cores from a series of lakes, ponds and bogs to determine when they came into being. Aiding me in this strenuous task were Eric Edlund, Eddie Matzger, Ken Ng and Rudy Goldstein. During this research, Greg and Stephanie Stubbs allowed me unrestricted use of their mountain home as a base camp, which made the physical hardships of my daily work far more bearable.

Hiking alone in the wilderness can be lonely and at times dangerous, and I thank those who've at times accompanied me, particularly on summit ascents: Ken Ng, Steve Rieser, John Mills and Rudy Goldstein.

Finally, this book project and my two-summer glacial research have been very stressful, as most mountain field work tends to be, and I thank my wife, Bonnie, and my daughter, Mary Anne, who endured my long absences from home.

First Edition August 1987
SECOND EDITION May 1992
Second Printing July 1997

Chapter 5 (Fish) by James H. Ryan; fish data in Chapters 7-18 also by James Ryan

Photographs by the author
Topographic map (in pocket) revised and updated by the author, based on U.S. Geological Survey maps

Library of Congress Card Catalog Number 92-10046
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Published by Wilderness Press
2440 Bancroft Way
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(800) 443-7227, FAX (510) 548-1355 Write, call, or fax us for a free catalog

Cover: Bull Run Peak above Sword Lake
Title page: The Iceberg (left) and the East Carson canyon, viewed from the summit of Stanislaus Peak

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I. Title.
GV199.42.C22C377 1992
917.94'4—dc20 92-10046
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Part One Introductory Cha

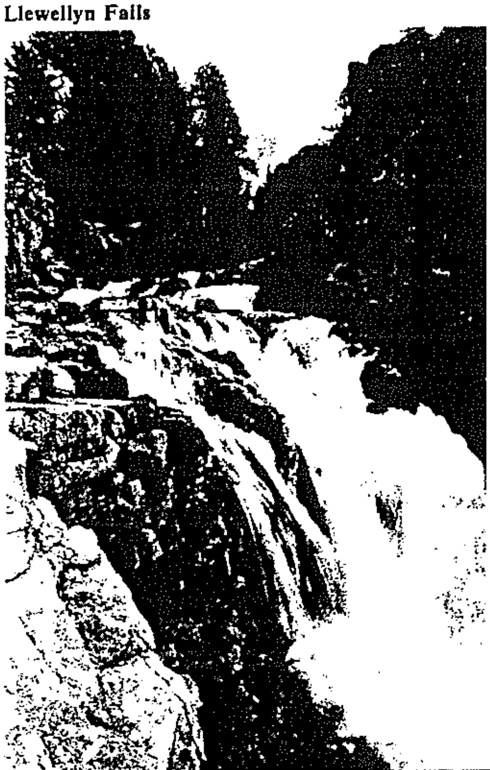
Part Two Route Chapte

Now we make a 400-foot descent, passing a grove of large junipers and then negotiating short, steep switchbacks down to the east edge of sagebrush-covered, cattle-populated **Upper Fish Valley**. Here you can expect to find a signed trail junction near a tall snow-depth marker. To follow Silver King Trail 1017 (incorrectly signed as 1701 in 1986) up-canyon, consult Route RF-7. If **Connells Cow Camp** is your goal, head across Upper Fish Valley to the union of Bull Canyon creek with Silver King Creek. From the campsite here, Route RF-6 starts a climb up a primitive trail to Whitecliff Lake.

Most folks, however, either stay near the corrals of the camp, which is under the Forest Service, or else head down-canyon to Commissioners Camp. Heading north toward that goal, one goes about 350 yards to a meeting of three fences, each with its own gate. Go through the north gate and follow the path that parallels the west side of the north-northeast-heading fence. The trail soon starts to curve northwest, climbs over a low moraine left by a retreating glacier, and crosses bedrock slopes to get you to a sign—perhaps still standing when you get here. From the sign you can head 120 yards south to a chorusing, 20-foot-high cascade, **Llewellyn Falls.**

Llewellyn Falls is a barrier that trout cannot ascend (upstream trout occasionally go over the falls unharmed). Perhaps as a giant glacier slowly retreated up Silver King canyon, perhaps about 140,000 years ago, cutthroat trout followed its path. They would have been able to swim into Upper Fish Valley and to higher valleys *if* they did so before Silver King Creek eroded away bedrock to form the falls. Once isolated, they evolved into a subspecies called Paiute cutthroat trout (*Salmo clarki seleniris*), or simply, Paiute trout. These trout became threatened by extinction through overfishing and also through introduction of Lahontan cutthroat and rainbow above Llwellyn Falls in the 1940s and '50s through human error. Paiute cutthroat readily cross bred with Lahontans and rainbows to form hybrids. This interbreeding was noted in 1963, and in 1964 Department of Fish and Game workers removed purebreds and treated Silver King Creek with rotenone to kill the hybrids. The purebreds were then reintroduced above the falls. Their population grew from about 150 in the late 1960s to about 600 in the early 1970s. However, some hybrids were missed, so a second rotenone treatment was done in 1976. This too failed to get all the hybrids.

Llewellyn Falls



In the early 1980s the U.S. Fish and Wildlife Service prepared a recovery plan for Paiute cutthroat of the Silver King Creek drainge. The plan, endorsed by the California Department of Fish and Game (CDFG) and by Toiyabe National Forest (TNF), had three elements: 1) salvage and replanting of hybrid trout in nearby waters for angling; 2) chemical treatment with the registered pesticide rotenone of all target waters above Llewellyn Falls; and 3) replanting with adult Paiute trout from identified streams not included in items 1 and 2. Work by CDFG, TNF and Trout Unlimited began in July 1991 with capture of about 1000 hybrids. The live trout were air lifted by helicopter and released in Tamarack and Poison lakes and in the East Carson River near Soda Springs Guard Station. Later, a far more intensive rotenone treatment was performed from Llewellyn Falls all the way up to the headwaters. This will be repeated in 1992 and '93, and later, if necessary, to remove hybrids arising from chemically unscathed eggs and missed adults.

Beyond the Llewellyn Falls gorge you enter fishing country as the trail descends briefly northwest to the south end of Lower Fish Valley. It then approaches Silver King Creek and reaches a white-bordered, carbonate spring just before leaving the creekside. Not

far past the spring, the trail again
Silver King Creek and then par
about 150 yards. Then, where
meanders west, you can walk alo
edge of the meander toward **Con**
Camp, which is located near the c

RF-6 Whitecli

Distances
2.7 miles (approx.) to Whitecliff L
3.6 miles (approx.) to Whitecliff P

Trailhead Same as the Route
head

Introduction Whitecliff Lake,
miles from Rodriguez Flat, certainl
of the most alpine and most isolat
the wilderness. But camping space
lake is minimal, and the lake's g
certainly lacks the forage necessar
It's doubtful that any equestrian w
ride to the lake anyway, particular
massive 1986 avalanche, which
stretch of trail virtually impassab
Backpackers are also rare, for the
trout, and fishing is prohibited d
And the strenuous nature of the
courages all but the most determi
taineers. These individuals are the
souls to take this route, for th
intimidating east face of Whitecliff
countless Class 5 routes up to t
Undoubtedly, virtually everyone wh
to the summit has made a much ea
which is described at the end of th
at virtually every peak in the wi
along its border, the summit views r
the labor of the ascent.

Description After you've trekke
from Rodriguez Flat to Connells C
you begin a hike upstream along
bank of Bull Canyon creek. Withi
yards you should be able to find
doned trail, and shortly thereafter
veers south. You continue in your s
tion, southwest, soon climbing au
shallow, broad gully. The trail
disappears before the head of the sw
maintaining a steady course y
quickly find its resumption on slo
Bull Canyon creek.

Now ½ mile up from the camp,
firs have yielded to red firs, and

43200 East Oakside Place

Davis, CA 95618

March 21, 2010

Jack Clarke, Chair

Lahontan Regional Water Quality Control Board

2501 Lake Tahoe Boulevard

South Lake Tahoe

CA 96150

Re: Proposed NPDES permit hearing for Paiute cutthroat trout restoration (poisoning of Silver King Creek, Carson-Iceberg Wilderness Area).

Dear Chair Clarke and Board Members:

With this letter we are requesting that you direct the Lahontan staff to postpone consideration of the Silver King Creek stream poisoning project now scheduled for the April 14-15 meeting until the June 9-10 meeting of your Board in South Lake Tahoe (Lahontan RWQCB website). The Final EIR on this project was released by the California Department of Fish and Game (CDFG) on March 16. The status of the EIS is unknown at this date: no Record of Decision has been filed, so far as we know. The Lahontan staff is requiring that comments on the NPDES permit be submitted by tomorrow, March 22 (exhibit A). This short period does not give us adequate time to review and compare the Final EIR with the NPDES permit, nor does it comply with a letter mailed to the public from the CDFG and the US Fish and Wildlife Service (FWS) last summer (exhibit B).

This NPDES hearing has been scheduled and postponed by the Agencies three times since last summer. One further postponement to give the public a fair chance to review and compare documents in this controversial project should not be a problem.

EXHIBIT 16

Our initial examination of the EIR indicates that information has appeared in the Final EIR that did not appear in earlier documents or in the Draft EIR/EIS. It will take us some time to analyze this information.

The project has been stopped in Federal Court twice in the past eight years. In 2004, the Lahontan Board took no action on the NPDES permit, correctly, in our opinion. The State Water Board, however, reviewed and certified the permit. In 2005, the Federal Court issued a Preliminary Injunction on the project and required the agencies to prepare a full EIR/S. And that is the final document that was released six days ago.

The CDFG and FWS have failed to conduct a species-level inventory of the non-target species that will be affected by the poisoning. The Agencies, however, are now conceding that the project may cause the loss of non-target species. Such long-term impacts violate specific language in the Lahontan Basin Plan and the Clean Water Act. Further, we have questioned both the need for the project and whether or not such a project would successfully eliminate non-native fish in the long-term.

We thank you for your attention to this matter and look forward to your reply..

Sincerely,

Nancy A. Erman

Nancy A. Erman

Don C. Erman

Don C. Erman

Encl: 2

California Regional Water Quality Control Board
Lahontan Region

Linda S. Adams
Secretary for Environmental Protection

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Arnold Schwarzenegger
Governor

Exhibit A

February 17, 2010

To Interested Persons:

PROPOSED WASTE DISCHARGE REQUIREMENTS AND NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT (ORDER) FOR CALIFORNIA DEPARTMENT OF FISH AND GAME PAIUTE CUTTHROAT TROUT RESTORATION PROJECT, ALPINE COUNTY

Please find (enclosed) proposed Waste Discharge Requirements and National Pollutant Discharge Elimination System Permit (Order) for California Department of Fish and Game Paiute Cutthroat Trout Restoration Project, Alpine County. The Water Board will consider this permit at its April 14 and 15, 2010 Board Meeting, in South Lake Tahoe, CA. Comments previously received (in July 2009) on the tentative Order will be shared with the Water Board for its consideration and do not need to be re-submitted. Water Board staff intend to circulate our response to these comments at least two weeks prior to the Board Meeting. Should you have additional comments (not previously submitted) that relate to changes made and reflected in this proposed Order, please submit your comments **by March 22, 2010.**

Should you have questions, please contact Bruce Warden at (530) 542-5416.

for
Douglas Cushman
Senior Water Resource Control Engineer

Department of Fish and Game
North Central Region
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670
(916) 358-2900
FAX (916) 358-2912

U.S. Fish & Wildlife Service
Nevada Fish and Wildlife Office
1340 Financial Blvd., Suite 234
Reno, NV 89502
(775) 861-6300
Fax (775) 861-6301

June 15, 2009

Dear Interested Party:

The California Department of Fish and Game (Department) and the U.S. Fish and Wildlife Service (USFWS) have proposed to apply rotenone formulation and potassium permanganate into Silver King Creek and associated tributaries between Snodgrass Creek and Llewellyn Falls to remove non-native trout to restore the native threatened species Paiute cutthroat trout (*Oncorhynchus clarkii seleniris*) to its historical habitat. The Department and the USFWS released a draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) in March 2009. The Lahontan Regional Water Quality Control Board (Regional Water Board) released a tentative National Pollution Discharge Elimination System (NPDES) permit for the Project in May 2009 (comments due June 5). Because of the time needed to prepare responses to public comments, the Department and USFWS will not finalize the EIS/EIR until late 2009. Therefore, no treatment of Silver King Creek and its tributaries using rotenone will occur this year. However, the Department and USFWS will continue conducting fishery and other aquatic surveys, including gill-netting of Tamarack Lake this year.

Once a final environmental document has been completed by the Department, the Regional Water Board will circulate a proposed NPDES permit for a 30-day public comment period prior to consideration of the permit at a public hearing of the Regional Water Board anticipated for January 2010.

Should you have questions, please contact Mr. Stafford Lehr, Department of Fish and Game, at (916) 358-2939 or Mr. Chad Mellison, U.S. Fish and Wildlife Service, at (775) 861-6300.

Sincerely,

Sandra Morey
Regional Manager
North Central Region

Robert D. Williams
State Supervisor
Nevada Fish and Wildlife Office

California Regional Water Quality Control Board
Lahontan Region

Linda S. Adams
Secretary for Environmental Protection

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Phone: (530) 542-5400 • Fax: (530) 544-2271
Internet: http://www.waterboards.ca.gov/lahontan

Arnold Schwarzenegger
Governor

Date Distributed: March 24, 2010

MEETING AGENDA

April 14 – 15, 2010

Lake Tahoe Community College
Board and Aspen Rooms
One College Drive
South Lake Tahoe, CA 96150

Wednesday, April 14, 2010

Regular Meeting:	3:00 p.m.
Dinner Break:	5:00 p.m.
Regular Meeting continued:	7:00 p.m. approximately

Thursday, April 15, 2010

Regular Meeting:	8:30 a.m.

Note: A quorum of the Regional Board will be dining at 5:00 pm on Wednesday, April 14, 2010 at Tep's Villa Roma, 3450 Lake Tahoe Blvd., South Lake Tahoe.

Supporting Document:
Supporting documents for agenda items are posted on our website at least 10 days prior to the scheduled meeting. If you wish to be added to the interested parties list for a specific agenda item, please contact the staff person listed with the item in the agenda announcement. To view or download documents, go to www.waterboards.ca.gov/lahontan. (see note below for information on the timing for submitting comments).

Submittal of Written Material for Water Board Consideration:
Comments on individual items are welcome and encouraged. Written comments on an agenda item must be submitted on or before the due date listed in the hearing notice associated with the agenda item. Hearing notices are distributed to persons who have indicated they want to receive information about a specific item and are posted on the Water Board's web site (www.waterboards.ca.gov/lahontan).

j. **Discussion of Litigation: In re East West Development V, LP, LLLP, et al., United States Bankruptcy Court for the District of Delaware, Case No. 10-10452 (BLS). Authority: Government Code section 11126(e).**

k. **Discussion of Personnel Matters. Authority: Government Code Section 11126(a).**

Wednesday, April 14, 2010 – Approximately 7:00 p.m.

INTRODUCTIONS

4. PUBLIC FORUM

Any person may address the Water Board regarding a matter within the Water Board's jurisdiction that is not related to an item on this meeting agenda. Comments will generally be limited to five minutes, unless otherwise directed by the Chair. Any person wishing to make a longer presentation should contact the Executive Officer at least ten days prior to the meeting. Comments regarding matters that are under development for future meetings will be restricted. (See http://www.waterboards.ca.gov/lahontan/board_info/agenda/upcoming.shtml#top)

5. MINUTES

Minutes of the Regular Meeting of March 10- 11, 2010 in Victorville (Laurie Applegate)

6. ADOPTION OF UNCONTESTED CALENDAR

Items denoted by (**) are expected to be routine and non-controversial. The Water Board will act on these items at one time without discussion. If any Water Board member, staff member, or interested party requests discussion, the item will be removed from the Uncontested Calendar to be considered separately. Requests to have an item removed from the uncontested calendar can be made in advance of the meeting by writing to the Water Board or by calling the Water Board's Executive Officer or the request can be made to the Water Board at the meeting on the Wednesday before the vote on the Uncontested Calendar.

NEW WASTE DISCHARGE REQUIREMENTS AND NPDES PERMIT

7. **California Department of Fish and Game, Paiute Cutthroat Trout Restoration Project (NPDES NO. CA0103209), Alpine County** (The Water Board will consider whether to adopt an NPDES permit that will regulate the discharge of rotenone to eradicate introduced fish species from portions of Silver King Creek and associated tributaries. Comments on the proposed order which was circulated on February 17, 2010 were to be submitted by March 22, 2010. The Water Board will not be accepting additional written comments on the proposed order. However, the Water Board will accept both written and oral comments at the Water Board meeting only on those changes from the previously circulated proposed order now being recommended for Water Board consideration. Public comments at the Water Board meeting will be limited to 15 minutes or less depending on the number of people that wish to address the Water Board.) (Bruce Warden)

California Regional Water Quality Control Board
Lahontan Region

Linda S. Adams
Secretary for Environmental Protection

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Arnold Schwarzenegger
Governor

April 5, 2010 [sent via e-mail only]

Nancy A. Erman
Dr. Don C. Erman
43200 East Oakside Place
Davis, CA 95618

SUBJECT: REQUEST FOR CONTINUANCE OF CONSIDERATION OF ISSUANCE OF NPDES PERMIT TO THE CALIFORNIA DEPARTMENT OF FISH AND GAME FOR ROTENONE APPLICATIONS TO SILVER KING CREEK

In your letter dated March 21, 2010, addressed to Jack Clarke, Water Board Chair you requested that the Water Board continue the consideration of the NPDES Permit to the California Department of Fish and Game (Department) allowing for the application of rotenone to Silver King Creek. The basis for your request was that the Department certified its Environmental Impact Report (EIR) on March 15, 2010 and filed the Notice of Determination on March 17, 2010, which was five days prior to the due date for comments on the proposed NPDES permit. Additionally, you indicated that a June 15, 2009 letter from the Department and the United States Fish and Wildlife Service (USFWS), the other project proponent, indicated that the Water Board would consider the permit for the application of rotenone at least 30 days after the EIR was certified. Lastly, you indicated that the USFWS has not issued its Record of Decision (ROD) for the project so it is premature for the Water Board to act.

I have reviewed your request and discussed it with the Water Board Chair. Despite the issues raised in your letter, the Chair has decided to place consideration of issuance of the NPDES Permit on the Water Board's April 14-15, 2010 meeting agenda. At the meeting, the Water Board will consider the comments submitted on the proposed NPDES permit and may consider your request to continue the matter.

Our rationale for not continuing the consideration of the Permit includes:

1. Agencies and the public have had at least 30 days to review and comment on the proposed NPDES permit after the draft EIR was circulated.

2. Despite the fact that the Water Board has made findings as a CEQA responsible agency for this particular matter, the issuance of an NPDES permit is exempt from CEQA pursuant to Water Code section 13389
3. The Department did not recirculate the final EIR before certification thereby indicating that there were no significant changes in the final EIR from the draft EIR.
4. Any issues you have with the final EIR should be directed to the Department, the lead agency for the EIR, and not to the Water Board, a responsible agency under the California Environmental Quality Act (CEQA) for this particular matter. .
5. The June 15, 2009 letter you cited was not signed by the Water Board. While the letter may have given you certain expectations, the Water Board is not bound by the commitments made by other agencies.
6. The CEQA finding in the NPDES permit to be considered by the Water Board has been modified from that in the proposed permit. The Water Board will accept comments on this modified CEQA finding when it considers adoption of the permit.
7. The Water Board is not required to wait for a federal agency to issue its ROD approving the EIS before it considers a permit for a project.
8. The Department has requested a permit to implement the project as analyzed in its EIR, described in its Report of Waste Discharge, and as reflected in the proposed permit. If the Water Board adopts a NPDES permit for the project, as proposed, and the Department wishes to make a material change in its proposed project due to the inconsistency of its project with that approved by the USFWS in its ROD, the Department would need to submit a revised report of waste discharge before it could implement a revised project.

If you have any questions on any aspect of this letter, please contact me at (530) 542-5412 or hsinger@waterboards.ca.gov.

Sincerely,

Harold J Singer

Harold J. Singer
Executive Officer

T:DFG PCT NPDES response to continuation.doc

California Regional Water Quality Control Board
Lahontan Region

Linda S. Adams
Secretary for Environmental Protection

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www.waterboards.ca.gov/lahontan

Arnold Schwarzenegger
Governor

April 6, 2010

TO ALL INTERESTED PERSONS:

TRANSMITTAL OF ADDITIONAL MATERIALS FOR APRIL 2010 LAHONTAN WATER BOARD MEETING, ITEM NO. 7, DEPARTMENT OF FISH AND GAME PAIUTE CUTTHROAT TROUT RESTORATION PROJECT

Enclosed please find the following additional materials for Item No. 7, California Department of Fish and Game, Paiute Cutthroat Trout Restoration Project.

1. Late Revision – Includes a revised CEQA Finding (although substantially the same) and changes made in response to comments received by the public.

2. Enclosure 5: Response to Comments on Tentative Order

3. Enclosure 6: Response to Comments on Proposed Order

On April 5, 2010, Department of Fish and Game provided the Water Board its presentation and supporting material for the Board members. Because of the volume of this material, we are unable to send you a hard copy. The materials are available for your review at our office.

Please call Bruce Warden at (530) 542-5416 if you have any questions concerning this material or contact us at (530) 542-5400 to arrange a time to review the materials.

Carrie Hackler

Carrie Hackler
Office Technician

Enclosures (3)

T:_Agenda Items/2010/April/SilverKing/Cover Memo to Commenters for late revisions etc

From: "Nancy A. Erman" <naerman@ucdavis.edu>
Subject: **Request/NPDES permit/Silver King/other info.**
Date: April 20, 2010 6:10:59 PM PDT
To: Bruce Warden <BWarden@waterboards.ca.gov>
Bcc: Julia Olson—Julia <JAOEarth@aol.com>

Bruce,

Several changes were made to the NPDES permit for poisoning Silver King Creek at the hearing last Wednesday, April 14, 2010. Would you please send me the final version of the permit as soon as it is ready? It is still not available on the Lahontan Board website.

Also, could you please tell me who wrote the attachment 2 to enclosure 5, titled "Master Response: Rare and Endemic Species Impacts" that was sent out to the public prior to the hearing? Was that submitted by the California Department of Fish and Game (CDFG) to the Lahontan Board, or was it written by the Lahontan staff? And who, specifically, wrote it?

We noted that a large notebook of information was submitted to the Board members from the CDFG. Board members were reading from it and referring to it during the hearing. That information has not been available to the public on the Lahontan website as of today, April 20, 2010, and it was not available on the Lahontan website prior to the April 14 hearing. Were these materials part of the EIR?

Thank you for your attention to these details.

Nancy Erman

From: "Bruce Warden" <BWarden@waterboards.ca.gov>
Subject: **Adopted NPDES Permit, DFG Paiute Cutthroat Trout Restoration Project, Silver King Cr, Alpine Co.**
Date: April 28, 2010 2:18:20 PM PDT
To: "Nancy Erman" <naerman@ucdavis.edu>
▶ 2 Attachments, 1.3 MB

Hi Nancy,

In response to your request by e-mail for the final NPDES permit: Attached is a cover sheet and the Adopted NPDES Permit for the California Department of Fish and Game Paiute Cutthroat Trout Restoration Project at Silver King Cr in Alpine County.

This version is in color, so attached maps with color legends and diagrams are easily followed.

In response to your questions:

Lahontan staff prepared all responses to comments on the NPDES tentative and proposed permit, including attachment 2 to enclosure 5.

DFG submitted hard copies to the Water Board's South Lake Tahoe Office, consisting of a compilation of 25 exhibits on April 5, 2010 for review by Water Board members in accordance with instructions for "Submittal of Written Material for Water Board Consideration" given in the Agenda Announcement for the April 14-15, 2010 meeting, to allow "time to distribute the material to Water Board members in advance of the meeting, providing the opportunity for the members to read and consider the information submitted." Electronic copies are not required, and were not submitted. Hard copies were available to the public at the April 14, 2010 Water Board meeting. These items are part of the Water Board process, not part of the CEQA process.

Please contact me if you have any other questions.

Bruce T. Warden, Ph.D.
Environmental Scientist
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Blvd.
South Lake Tahoe, CA 96150
(530) 542-5416
(530) 544-2271 fax
bwarden@waterboards.ca.gov
Due to the Governor's Executive Order, I will be out of the office on the first, second and third Fridays every month.

Linda S. Adams
Secretary for
Environmental Protection

California Regional Water Quality Control Board

Lahontan Region

2501 Lake Tahoe Boulevard, South Lake Tahoe, California 96150
(530) 542-5400 • Fax (530) 544-2271
http://www.waterboards.ca.gov/lahontan

Arnold Schwarzenegger
Governor

April 28, 2010

INTERESTED PERSONS AND AGENCIES:

ADOPTED NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

Enclosed is a copy of Board Order No. R6T-2009-0015 that was adopted at the Regional Board meeting held in South Lake Tahoe, CA on **April 14, 2010.**

Any person aggrieved by this action of the Regional Water Board may petition the State Water Board to review the action in accordance with Water Code section 13320 and California Code of Regulations, title 23, sections 2050 and following. The State Water Board must *receive* the petition by 5:00 p.m., 30 days after the date of the Order, except that if the thirtieth day following the date of this Order falls on a Saturday, Sunday, or state holiday, the petition must be received by the State Water Board by 5:00 p.m. on the next business day. Copies of the law and regulations applicable to filing petitions may be found on the Internet at: http://www.waterboards.ca.gov/public_notices/petitions/water_quality or will be provided upon request.

Bruce Warden
Environmental Scientist

Enclosure

JULIA A. OLSON
WILD EARTH ADVOCATES
2985 ADAMS ST.
EUGENE, OR 97405
541-344-7066
JAOEARTH@AOL.COM

March 22, 2010

Harold Singer, Executive Officer
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Blvd
So Lake Tahoe, CA 96158

Attn: BWarden@waterboards.ca.gov

RE: Proposed Waste Discharge Requirements and NPDES Permit (Order) for California Department of Fish and Game Paiute Cutthroat Trout Restoration Project, Alpine County.

Dear Mr. Warden and Mr. Singer,

I write on behalf of my clients Californians for Alternatives to Toxics and Wilderness Watch to request that the hearing in front of the Lahontan Regional Water Quality Control Board be set for the June Lahontan Board meeting in South Lake Tahoe, rather than the April meeting.

Moving the hearing is necessary in order to allow the public an opportunity to fully review the Joint EIR/EIS that was just recently released and to allow time for USFWS and the Forest Service to issue their Record of Decision under NEPA. Until that happens, we will not know the ultimate decision of the federal agencies. The Final EIR/EIS appears to have changed in some significant respects from the Draft EIR/EIS, but without an opportunity to fully review that document, my clients (and I) cannot be expected to submit substantive comments on the proposed NPDES permit. Notably, for many of my clients, the Final EIR/EIS is only available online and is quite time consuming to review. Some do not have access to fast internet service and cannot in one week's time be expected to review such a large document.

This is a significant project on which we have submitted comments every step of the way, including many comments to the Lahontan Board. The public is entitled to meaningful participation at this last stage prior to the Board deciding whether to permit poisoning of aquatic habitat in wilderness. In fact, DFG's letter of June 15, 2009 indicated that the Final EIS/EIR would be released prior to any NPDES permit or hearing on such. Yet, to date, no decision has been made by the federal agencies on the Final EIS/EIR.

Thank you for considering our request. I look forward to hearing from you.

Sincerely,
/s/
Julia A. Olson
Counsel for CATs and Wilderness Watch

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Attorneys for Petitioners

THE SUPERIOR COURT OF THE STATE OF CALIFORNIA
IN AND FOR THE COUNTY OF SACRAMENTO

CALIFORNIANS FOR ALTERNATIVES TO TOXICS, a California non-profit corporation, WILDERNESS WATCH, a Montana non-profit corporation, THE FRIENDS OF SILVER KING CREEK, a California non-profit corporation, and LAUREL AMES and DR. ANN MCCAMPBELL, individuals, Petitioners, v. CALIFORNIA DEPARTMENT OF FISH AND GAME, a state agency, DOES 1-100, Respondent.	Case No. **VERIFIED PETITION FOR WRIT OF MANDATE** (Pub. Res. Code §§ 21168 21168.5, Cal. Civ. Proc. §§ 1094.5)

Californians for Alternatives to Toxics, Wilderness Watch, The Friends of Silver King Creek, Laurel Ames and Dr. Ann McCampbell ("Petitioners") hereby respectfully petition this Court for a Writ of Mandate pursuant to California Code of Civil Procedure § 1094.5, declaring unlawful and setting aside Respondent California Department of Fish and Game's ("CDFG or Respondent") Final Paiute Cutthroat Trout Restoration Project Environmental Impact Statement/Environmental Impact Report ("EIR" or "EIS/EIR") under the California Environmental Quality Act ("CEQA"), California Public Resources Code §§ 21000 *et seq*.

Petitioners allege:

ALLEGATIONS

INTRODUCTION

1. Petitioners, in bringing this action, challenge CDFG's violation of CEQA in completing, approving and certifying the EIR, Findings of Fact and Statement of Overriding Consideration involving the poisoning with rotenone of 11 miles of the Silver King Creek stream system, including tributaries and backwaters, in the Carson-Iceberg Wilderness of the Humboldt-Toiyabe National Forest in California, for the purpose of killing non-native fish (some of which were previously planted by CDFG) as part of a recovery effort for Paiute cutthroat trout, without fully complying with the mandates of CEQA.

2. CDFG has violated CEQA. In the EIR/EIS, CDFG has (i) improperly narrowed the objectives, purposes, and need for the EIR, (ii) failed to provide a complete environmental baseline against which to evaluate impacts of the poisoning project, (iii) failed to consider and evaluate a reasonable range of alternative actions, (iv) failed to adequately consider, analyze, and disclose the direct, indirect, and cumulative impacts of the poisoning project, (v) failed to adopt feasible alternatives to the poisoning project in order to mitigate or avoid the significant adverse impacts of the project, (vi) disregarded the best available science in evaluating impacts and (vii) failed to support its decision with substantial evidence in the record.

3. For decades, CDFG has stocked non-native species of trout in wilderness lakes and

streams throughout California. Largely because of this practice, populations of native trout and other native species have declined to the point where certain species have been listed as threatened or endangered under the Endangered Species Act ("ESA"). However, the practice of stocking non-native fish continues, as is evidenced by CDFG's recent decision to continue fish stocking in its Fish Stocking/Hatchery Programmatic EIR/EIS, currently being challenged in this superior court by multiple parties.

4. Subsequent to the decline of certain native trout species, CDFG has implemented projects in different stream systems in California to kill non-native fish, and reintroduce native trout. Rotenone is the most common aquatic pesticide used for this purpose. In fact, between 1964 and1993, CDFG poisoned other reaches of Silver King Creek eight times with rotenone and one time with antimycin. As late as 1991, while CDFG was implementing another poisoning of the Silver King Creek basin, it planted non-native trout in Tamarack Lake, a lake that had been proposed for poisoning as part of this rotenone project.

5. Similar projects as this have failed to enhance populations of native cutthroat trout. Rotenone projects have failed repeatedly in this river basin, and throughout the West, while causing significant damage to the beneficial uses of streams by native macroinvertebrates, amphibians and non-target native fish. Meanwhile, stocking of non-native fish continues.

6. The record shows that CDFG has a history of non-compliance with applicable laws and permits, of chemical accidents and of misrepresenting monitoring results pertaining to past rotenone poisoning in the Lahontan Region, and elsewhere in California. Notably, six of eleven rotenone projects in the Lahontan Region between 1988 and 1994 violated water quality standards.

7. The 11 miles of the Silver King stream system to be poisoned have a high probability of containing rare and/or endemic aquatic macroinvertebrates and amphibians. Past monitoring by

Fish and Game of non-target species in other reaches of the Silver King Creek system has shown clear evidence of long-term changes to the biotic community from the use of rotenone. Even three years after the poisoning of other reaches of Silver King Creek with rotenone, the diversity and abundance of aquatic invertebrate species did not repopulate the reaches with the same or similar diversity and abundance of species. Other published studies have shown loss of non-target species, and food web and community changes from the use of rotenone.

8. Rotenone is an aquatic pesticide that interferes with oxygen use and is especially toxic to organisms that obtain oxygen from water, such as fish, amphibians and aquatic invertebrates. Certain species of aquatic invertebrates are particularly susceptible to long-term or permanent extirpation from streams poisoned by rotenone. Rotenone also has indirect lethal and sublethal effects because amphibians, birds and other species will likely suffer from depleted food sources as rotenone will decrease insect populations and other macroinvetebrates and will eliminate fish populations.

9. The project is unnecessary for the survival of Paiute cutthroat trout. The Paiute cutthroat trout is already established in 11.5 miles of this stream, in two other creeks within the same watershed, and in four populations in other watersheds in the Sierra Nevada. Together, these stream reaches surpass the species' known historic range. Paiute cutthroat trout may remain threatened, in part, because CDFG intends to continue its program to stock downstream areas hydrologically connected to Silver King Creek with non-native trout.

10. Because the rotenone project is proposed in a wilderness on Forest Service lands, the Forest Service must first approve CDFG's use of motorized equipment, pesticides, and/or chemical treatments to waters and its exceedence of the maximum number of people allowed in wilderness. The United States Fish and Wildlife Service ("USFWS") is a federal lead agency for the project in

conjunction with the cooperation of the Forest Service. The Lahontan Regional Water Quality Control Board must issue an NPDES ("National Pollutant Discharge Elimination System") permit pursuant to the Porter-Cologne Water Quality Control Act and the Federal Clean Water Act.

11. Petitioners seek a writ of mandate directing DFG to set aside its EIR and conduct further environmental review and analysis, as required by CEQA, and order certain injunctive relief.

PARTIES

12. Petitioner CALIFORNIANS FOR ALTERNATIVES TO TOXICS ("CATs") is a nonprofit public interest group, which has advocated on behalf of its members regarding pesticide use by the State of California and the federal government for more than 25 years. CATs' office is based in Eureka, California. CATs seeks to voice and advocate public concerns regarding toxic chemicals in the environment through organizing, education, advocacy and building community leadership. This mission is grounded in a broader concern about the sustainability of the environment. CATs and its members are actively involved in local, regional, national and international governmental and regulatory processes concerning the use of toxic chemicals, including aquatic pesticides. Members of CATs depend for their livelihood, health, culture and well-being on the health and productivity of forests in California, including the Humboldt-Toiyabe National Forest. Members of CATs live near or visit the Humboldt-Toiyabe National Forest, including the Silver King Creek area of the Carson-Iceberg Wilderness ("Project Area"). CATs members drink water that is discharged from the Project Area. CATs members also observe, study, recreate, gather or otherwise enjoy the biologic, scientific, and aesthetic benefits of the Project Area. CATs members have an interest in knowing that the Project Area exists in its natural state, alive with wildlife, still beautiful and available to visit when they choose. The entire Project Area is a valuable asset to CATs members. No member of CATs has been compelled to participate in this lawsuit.

13. Petitioner WILDERNESS WATCH is a nonprofit organization registered in Montana

whose mission is to provide citizen oversight to ensure the long-term preservation of America's wilderness and wild and scenic rivers. Wilderness Watch is the only organization dedicated solely to monitoring and protecting wilderness and wild and scenic rivers nationwide. Wilderness Watch is headquartered in Missoula, Montana, and has chapters in Mammoth Lakes and Sonora, California. Members of Wilderness Watch enjoy backpacking, hiking, snowshoeing, horse packing, fishing, and other non-motorized activities in the Carson-Iceberg Wilderness, in which they seek to experience the beauty, the diverse ecology, the pristine waters, peace, and the solitude found within the area. Wilderness Watch members are concerned about the poisoning of streams in Wilderness Areas and the adverse effects to water quality and aquatic species. No member of Wilderness Watch has been compelled to participate in this lawsuit.

14. THE FRIENDS OF SILVER KING CREEK is a nonprofit organization registered in California whose mission is to protect the Sierra Nevada from unwarranted poisoning on the pubic lands, forests, and waters that comprise thousands of acres in the Sierra. The Friends of Silver King Creek is the only organization in the Sierra focused on projects that are reliant on poison to manage the public land. Members of Friends of Silver King Creek actively participate in hiking, back-country skiing, backpacking, and other muscle-powered activities in the Sierra Nevada. The Friends of Silver King Creek are based in Markleeville, California and near to the Carson-Iceberg Wilderness, the Pacific Crest Trail, and adjacent roadless forests in the Sierra. The members of Friends of Silver King Creek are particularly concerned with the impacts of poison on all ecosystems of the Sierra, recognizing that poisons used for fish management, weed control, and shrub reduction are non-target poisons that impact the water, the land, the vegetation, the animals as well as the invertebrates, fungi, and more. The members are also concerned that the management actions using poisons have the strong likelihood to significantly alter the structure and function of creeks, forests,

meadows, and other habitats. No member of Friends of Silver King Creek has been compelled to participate in this lawsuit.

15. Petitioner LAUREL AMES is an individual and a former board member of the Lahontan Regional Water Quality Control Board, appointed by Governor Ronald Reagan. Ms. Ames has been a resident of the eastern Sierra for five decades, during which time she has hiked and backpacked throughout the Sierra Nevada. She recreates in the Silver King Creek area, and is concerned about the impacts this project would have on beneficial uses of water, and on her recreational experiences. She is also concerned about the ongoing use of rotenone throughout the Sierra Nevada.

16. Petitioner ANN MCCAMPBELL, MD, is an individual who lived most of her life in California where she has enjoyed and recreated in the Sierra Nevada. She is a physician with an interest in environmental health and a passion for protecting wilderness areas. Because of her concern about the adverse impacts of pesticides on humans and the environment, she has been an advocate of integrated pest management (IPM) for the past twelve years. She is particularly concerned about the widespread practice of putting poisonous substances in pristine waters for the purpose of native fish restoration.

17. The health, recreational, scientific, cultural, inspirational, educational, aesthetic and other interests of Petitioners will be adversely and irreparably injured by CDFG's failure to comply with CEQA, unless the relief requested here is granted. These are actual, concrete injuries to Petitioners that would be redressed by the relief sought. Petitioners have no adequate remedy at law.

18. In order to safeguard their interests, Petitioners actively participated in the public planning process for the rotenone project, both at the federal and state level. Petitioners submitted comments during the formal comment period on the EA. Petitioners timely appealed the FONSI. In

addition, Petitioners commented on CDFG's application for an NPDES Permit before the Lahontan Regional Water Quality Control Board.

19. Respondent California Department of Fish and Game is the California state public agency responsible for properly managing and protecting California's fish and wildlife, for their public ecological, recreational, and other values, and is the agency which certified and approved the EIR.

20. The true names and capacities, whether individual, corporate or otherwise, of DOES 1 through 100, are unknown to Petitioners who therefore sues said Respondents by such fictitious names and will seek leave to amend this Petition for Writ of Mandate when they have been ascertained.

JURISDICTION

21. The Court has jurisdiction pursuant to California Code of Civil Procedure §§ 1085, 1094.5 and California Public Resources Code §§ 21167 and 21168.5. Venue is proper pursuant to California Code of Civil Procedure § 401.

BACKGROUND

22. The Humboldt-Toiyabe National Forest is graced with numerous natural treasures, including the streams and lakes of the Carson-Iceberg Wilderness Area. The Carson-Iceberg Wilderness Area is the home to many species, which are threatened with adverse impacts from pesticide use, grazing, development and other activities which disrupt ecosystem functioning.

23. The project at issue in this lawsuit has been proposed several times. On May 29, 2002 CDFG filed a CEQA Mitigated Negative Declaration and a Notice of Determination on April 10, 2003. On July 31, 2002, the Forest Service issued for public comment an Environmental Assessment under the National Environmental Policy Act ("NEPA") for the proposed Paiute Cutthroat Trout Recovery Project.

24. On March 13, 2003, the Forest Service wrote a letter to those who commented on the

2002 EA, indicating that the Forest Service would not issue a final NEPA decision, but instead would use a "minimum tools analysis" to determine whether to allow the proposed project, or some modified version of it, within the wilderness. The Forest Service later approved the rotenone project without formally responding to public comments on its 2002 EA, and without issuing a decision document under NEPA that would have been subject to administrative appeal.

25. After being sued by the Center for Biological Diversity, the Forest Service entered into a settlement agreement with those plaintiffs whereby it agreed to withdraw its approval for the project and prepare an EA or EIS in full compliance with NEPA.

26. After public review of a new Draft EA, on April 30, 2004, the Forest Service signed the Finding of No Significant Impact, which adopted the proposed action. On May 5, 2004, the Forest Service issued its Final EA.

27. In the summer of 2005, CDFG petitioned the State Water Resources Control Board ("State Board") to adopt the NPDES Permit for the project, after the Lahontan Regional Water Quality Control Board declined to do so. On July 6, 2005, the State Board adopted the Water Quality Order issuing the NPDES Permit to CDFG, thus, allowing the rotenone project to proceed.

28. Thereafter, CATs, Wilderness Watch, Laurel Ames* filed a federal lawsuit in the United States District Court for the Eastern District of California challenging the Forest Service's decision approving the 2004 project. (No. Civ. S–05–1633 FCD KJM). Judge Damrell issued a temporary restraining order and a preliminary injunction in that case and later dismissed the case after the Forest Service rescinded its decision. In defending the lawsuit, the agencies, including CDFG, argued that if they could not conduct the project in 2005, they would never be able to do so because of lack of funding.

29. Nonetheless, on June 2, 2006, USFWS issued a Notice of Intent to prepare an

Environmental Impact Statement ("EIS") under NEPA for the project and began conducting scoping. USFWS did not mention CDFG or a joint EIS/EIR in its first scoping notice.

30. After USFWS received scoping comments requesting a joint EIS/EIR with the Forest Service and CDFG, CDFG published a CEQA Notice of Preparation on September 16, 2008.

31. On March 20, 2009, USFWS, the Forest Service (as a cooperating agency) and CDFG issued the Draft Joint EIS/EIR. Petitioners timely submitted comments on the Draft EIS/EIR, asserting among other things that it is deficient under CEQA and NEPA on procedural grounds, and portended a violation of substantive laws.

32. On March 15, 2010, CDFG published and certified, with a statement of overriding considerations, the Final Joint EIS/EIR. On March 17, 2010 CDFG published its Notice of Determination.

33. On April 10, 2010, USFWS, and the Forest Service as a cooperating agency, published the Final EIS/EIR, but they have not yet issued a Record of Decision for the project and are still accepting public comments.

34. All prior challenges to the environmental review of this project have proceeded in federal court. However, at the date of this petition, a federal challenge is not ripe for review under the Administrative Procedures Act. The statutory deadline for filing claims against the CEQA decision expires on April 16, 2010. Petitioners have provided notice of the commencement of this action to Respondents, attached as Exhibit A.

<u>THE PROJECT AND ALTERNATIVES</u>

35. The primary objective of the project is to establish Paiute cutthroat trout as the only salmonid fish species in Silver King Creek, in order to prevent the risk of hybridization above Llewellyn Falls. The EIR describes the risk of hybridization as a "bucket biologist," someone who illegally transplants fish, taking a non-native fish from below Llewellyn Falls and moving it up to

the area above the falls, which is inhabited by the pure strain of Paiute cutthroat trout.

36. Secondary objectives include preventing extinction of Paiute cutthroat trout, avoiding genetic bottlenecking and stochastic events and facilitating the removal of the species from the federal threatened species list. Other objectives include using a method of non-native fish removal that is feasible to implement, which complies with applicable laws, protects health and safety and minimizes environmental impact.

37. The EIS/EIR considered a no action alternative and two action alternatives. The No Action alternative evaluated continuing current management practices, but included a new commitment by the agencies to develop informational handouts to inform anglers of the risks associated with the Paiute cutthroat trout. Under current management, agency personnel will have a presence along these creeks "as budgets allow."

38. The Preferred Alternative is to poison 11 miles of streams on Silver King Creek, its associated tributaries, seeps and springs with a rotenone formulation up to two times a year for two to three years. Rotenone is a piscicide that kills gill-breathing organisms including fish, amphibians and benthic macroinvertebrates (aquatic insects) in their aquatic life stages.

39. As of 2009, the EPA has banned use of rotenone in marine and estuarine environments. Rotenone is linked to Parkinson's disease in humans. As a result, the use of rotenone on land or in agriculture has ceased and its manufacturers have not sought reregistration by EPA for rotenone's use on land.

40. Another chemical, potassium permanganate, would be used to neutralize downstream the effects of rotenone, one of the chemicals in the formulation. CFT Legumine, the rotenone formulation proposed for use, also contains inert ingredients that are potentially toxic. The EIR states that inert ingredients are expected to persist in the water for up to two weeks.

41. Potassium permanganate may not neutralize other chemicals or ingredients in the rotenone formulation. It is also unknown whether potassium permanganate neutralizes the other active ingredients, unspecified cube resins that are present in CFT Legumine, the rotenone formulation to be used in the project. The EIR failed to discuss or evaluate a number of the active ingredients in CFT Legumine. CDFG also failed to evaluate or sample sediments for piperonyl butoxide, an active ingredient in past rotenone projects in Silver King and known to persist in sediments.

42. The Preferred Alternative would use generator-powered volumetric augers to administer the potassium permanganate to eliminate the toxic effects of rotenone downstream of the project area.

43. Dead fish would be captured in nets downstream and buried in wilderness at sites chosen by the Forest Service.

44. After poisoning for two to three years, the agencies would begin restocking Paiute cutthroat trout.

45. The Preferred Alternative does not include poisoning Tamarack Lake, which was proposed for poisoning in the 2003 and 2005 versions of this same project and considered as a possible future action in the EIR. Based on 2001-2009 fishery surveys, the lake is deemed fishless. The same evidence of Tamarack Lake's fishlessness existed in 2004, but was disregarded in the prior project proposals, which all included lake poisoning. The USFWS Recovery Plan for the Paiute cutthroat trout calls for the poisoning of Tamarack Lake.

46. According to the EIS/EIR, the poisoning can only occur from mid-August to mid-September due to biological and physical constraints.

47. Prior to poisoning, the agencies will survey for amphibians proposed for listing under

the Endangered Species Act and if they are found, the agencies will remove them, to the extent practicable and relocate them in other waters within the drainage, but outside of the project area.

48. The Agencies would conduct benthic macroinvertebrate population monitoring, but would do nothing to protect any invertebrate species, including pre-project removal.

49. Monitoring would continue in years 1, 2, 3, and 5 post-treatment.

50. Effective May 21, 2009, the California Fish and Game Commission increased the daily bag limit for fish in the area to be poisoned in order to assist with pre-project fish removal. This regulation in support of the project was adopted 10 months prior to the completion of the final EIR/EIS.

51. Each year, the poisoning effort will require up to 50 people and an undisclosed number of pack stock entering and sleeping in the wilderness. In order to protect wilderness character, the Forest Service limits wilderness access at any one time to 15 people.

52. The preferred alternative does not guarantee 100% success in removal of non-native or hybridized trout. In fact, there is no evidence that over time, the physical removal methods (the third alternative) will not produce the same likelihood of success as repeated stream poisoning.

53. In order to isolate the project area from non-native fish, the project depends upon alleged downstream impassable barriers. In response to comments, the EIR concedes that the agencies cannot definitively state that no rainbow trout could ever pass the project's downstream barriers. They characterize the possibility as "remote," but admit that under ideal conditions a fish could pick its way upstream. The single report on which the EIR relies was prepared by an hydraulic engineer for CDFG, who only viewed the alleged barrier under low flow conditions and did not witness the multiple flow paths at high stream flow. In contrast, Dr. Erman, a fisheries biologist, has commented to CDFG on this project that the alleged barrier is not impassable for

rainbow trout.

54. In its Findings of Fact, CDFG incorrectly claims that, “[t]hese barriers, the two highest being eight and ten feet high, would geographically isolate Paiute cutthroat trout from other trout species and greatly reduce the likelihood of an illegal introduction.” (Findings of Fact, p.5). The agencies cannot guarantee that result because they cannot rule out that at least some fish will be able to migrate back upstream during high water.

55. The EIR does not explain why there would be less risk of an illegal introduction of non-native trout further downstream, when the project area immediately abuts a stretch of stream with non-native trout, just below the alleged impassible barriers. If the agencies’ concerns about illegal introductions above Llewellyn Falls are legitimate, then it is also likely that a bucket biologist will reinfect the project area with a non-native trout.

56. The third alternative includes the use of non-chemical means to remove non-native trout from the project area. Electrofishing, gill netting, seining and other physical methods of removal would be used. According to the EIR, this alternative would have lower annual efficiency than poisoning, but could achieve the project’s goal of removing non-native fish after at least 10 years of implementation. There would be a small risk that small fish would remain uncaptured.

57. The physical removal alternative would involve 72 days of work during the summer by a group of 11 people. This number would be below the wilderness limit and not require a special Forest Service permit.

58. This alternative would be implemented in late June or early July to mid-October because of access, streamflows and good weather.

59. The primary difference in the two alternatives is that the preferred alternative involves poisoning and killing nearly everything in the treated stream system, including causing the

potential extinction of other species, as rare and unique as the Paiute cutthroat trout. In terms of project success, the preferred alternative's primary advantage is that it could achieve its goals more quickly than the physical removal alternative and would cost less in terms of cash, but much more in terms of ecological costs. If the EIR/EIS had factored in the costs of lost species, biodiversity, species abundance and assemblages, human health risks and wilderness values, the true costs of the preferred alternative would greatly exceed the costs of the physical removal option.

60. The EIR states that cost was not used to screen out any alternatives and was only used to compare options that were approximately equal in efficacy and impact, namely the two action alternatives.

61. The physical removal alternative would create more jobs.

62. The EIS/EIR failed to consider other alternatives raised by the public, including prohibiting fishing in this area, providing greater ranger patrol and educating the public about the danger of transplanting fish above Llewellyn Falls. None of the alternatives address one of the primary purposes of the project, which is to prevent a "bucket biologist" from taking a hybridized or non-native fish from below Llewellyn Falls and transplanting it above the Falls, thereby contaminating the pure Paiute cutthroat habitat. Even if the preferred alternative succeeded in expanding the habitat of a pure strain of Paiute cutthroat trout, there still remains the risk that a non-native fish could be planted in that habitat from just downstream where non-native trout are plentiful.

63. In fact, CDFG continues to stock non-native trout downstream of the project area.

64. CDFG and USFWS's recent Fish Stocking and Hatchery EIR/EIS allows CDFG to continue stocking non-native fish in this watershed and stream system.

IMPACTS

65. Nearly a decade after this project was first conceived, the agencies still have not conducted a macroinvertebrate species inventory in the project area and stream drainage to determine what non-target species are in the area.

66. The project has a high probability of affecting or eliminating endemic and rare, non-target species. It is clear that the prior poisoning of the Silver King drainage caused long-term adverse effects to aquatic invertebrates. CDFG admitted in response to comments in the Final EIR/EIS that impacts to aquatic invertebrates lasted at least three years after the final rotenone treatment within Silver King Creek basin in 1993. As recently as 2003 and based on the same data, in a report to the Lahontan Regional Water Quality Control Board, CDFG denied that these impacts to aquatic invertebrates lasted at least three years.

67. No species level inventory has yet been made of aquatic macroinvertebrates in Silver King Creek. Thus, the only reason the EIR/EIS is unable to identify specific endemic invertebrates is because the agencies have not looked for them. The EIR/EIS does concede, however, that the preferred alternative's poisoning could result in loss of rare or endemic species, which would be a significant and unavoidable impact.

68. Studies show that rotenone causes significant, long-term effects on aquatic invertebrates. For example, a five-year study showed that up to 100 percent of mayflies, stoneflies and caddisflies were missing after a second rotenone application and that five years later, 21 percent of the taxa and 19 species were still missing. Significant reduction in population levels of invertebrates and extermination of certain species is a probable result of the project. These waters will likely be recolonized by "weedy" species, i.e., those that disperse and colonize rapidly by flight and thrive in disturbed habitats.

69. The EIR does not adequately assess the effect of the project on terrestrial and other

species that rely on emerging aquatic insect adults as a food source. Fall is the time of year when new generations of most insect species are in the water. Most insects have a one-year life cycle. Three years of poisoning could reduce four years of insect generations of many species. The stream poisoning will significantly depress, or possibly completely eliminate, a critical food supply for non-target species for at least four years. Species such as the yellow warbler and the willow flycatcher, both designated forest sensitive species, will be significantly affected.

70. The mountain yellow-legged frog and Yosemite Toad are found in the Silver King basin and would also be adversely affected by the poisoning. The mountain yellow-legged frog spends up to four years as a tadpole and is highly aquatic compared to other amphibian species. There is no time during the year when tadpoles would not be in the stream system. The mountain yellow-legged frog is warranted for listing as an endangered species and is classified as a sensitive species by the Forest Service.

71. The EIR does not fully disclose and evaluate the impacts of the incidence of unintended fish kills or persistence of toxic substances in the stream system and lake, based on Fish and Game's prior record of rotenone projects. During past rotenone projects, Fish and Game has failed to comply with other agencies' requirements, and its actions have resulted in fish kills downstream of the project, and persistence of toxic substances in streams.

72. During rotenone poisoning of Silver King Creek in Mono County in 1992, more than 1000 fish were unintentionally killed downstream of the project area from the application of potassium permanganate. The following year, 1993, during a repeat poisoning of the same area, detoxification of the rotenone was chemically incomplete. The record shows that CDFG has difficulty managing the performance of potassium permanganate and detoxifying the rotenone. Evidence from the 2007 Lake Davis poisoning demonstrates the inability of CDFG to properly apply

rotenone according to label requirements and to meet their own target concentrations.

73. In the Lahontan Region alone, 6 of 11 rotenone projects between 1988 and 1994 violated water quality standards. Rotenone, rotenolone, or naphthalene were detected outside project boundaries or persisted longer than limits established by water quality standards.

74. The project will result in a violation of the Water Quality Control Plan for the Lahontan Region (Basin Plan), and thus, the Federal Water Pollution Control Act (the "Clean Water Act" or “CWA”), 33 U.S.C. §§ 1251 *et seq*., and the Porter-Cologne Water Quality Control Act ("Porter-Cologne Act"), Water Code §§ 13000 *et seq*.

75. Rotenone treatment of streams in this watershed also compromises the streams’ use as reference sites upon which biological criteria may be based. Wilderness stream systems are the best source of establishing biological criteria for water quality because of their relative unaltered conditions. Poisoning these systems eliminates an important source of scientific baseline study.

76. In pursuing this action, Petitioners will confer a substantial benefit on the People of the State of California and therefore are entitled to recover from DFG reasonable attorney's fees pursuant to § 1021.5 of the Code of Civil Procedure.

77. Petitioner has provided notice of the commencement of this action to Respondents, as provided in Exhibit A attached hereto.

FIRST CAUSE OF ACTION: VIOLATION OF CEQA

78. Petitioners hereby incorporate by reference all preceding paragraphs.

79. CEQA requires, among other things, that an EIR properly describe the objectives, purposes, and need for the EIR (tit. 14, Cal. Code of Regs., § 15124); properly describe the environmental baseline against which to evaluate impacts of the poisoning project in a meaningful context (tit. 14, Cal.Code of Regs., §§ 15125, 15360); consider and evaluate a reasonable range of alternatives (Pub. Res. Code § 21100 & tit. 14, Cal.Code of Regs., § 15126.6); adequately consider, analyze, and disclose the direct, indirect, and cumulative impacts of the program (Pub. Res. Code §

21100 & tit. 14, Cal. Code of Regs., §§ 15126, 15126.2, 15143); the agency adopt specific reasonable mitigation measures or feasible alternatives for the significant adverse impacts of the project or program (Pub. Res. Code § 21100 & tit. 14, Cal. Code of Regs., § 15126.4. An agency's decision, its statement of overriding considerations and findings must be supported by substantial evidence. (Pub. Res. Code §21168.5 & Code of Civil Procedure §1094.5.)

80. CDFG prejudicially abused its discretion and failed to proceed according to law by certifying and approving the Paiute Cutthroat Restoration Project EIS/EIR, which violates CEQA, among other laws, because it (i) improperly narrowed the objectives, purposes, and need for the project, (ii) used an improper environmental baseline against which to evaluate impacts of the project in a meaningful context, (iii) failed to consider and evaluate a reasonable range of alternative actions, (iv) failed to adequately consider, analyze, and disclose the direct, indirect, and cumulative impacts of the project, (v) failed to adopt feasible alternatives or specific reasonable mitigation measure for the significant adverse impacts of the project, (vi) disregarded the best available science in evaluating impacts in the EIR, and (vii) failed to support its decision with substantial evidence in the record. CDFG's actions in completing, approving, and certifying the EIR violates its duties under CEQA, among other things, and constitutes a prejudicial abuse of discretion that is actionable under Pub. Res. Code § 21168.5 and Civ. Pro. Code § 1094.5.

81. CDFG prejudicially abused its discretion and failed to proceed according to law because the conclusions, findings and statement of overriding considerations in and for the EIR/EIS, which Petitioners challenge, are not supported by substantial evidence in the record.

RELIEF REQUESTED

Petitioners respectfully request that the Court enter judgment as follows:

1. Pursuant to Public Resources Code §§ 21168.5, and Code of Civil Procedure §1094.5, issue an alternative and preemptory writ of mandate that invalidates the CDFG's decision approving the Paiute Cutthroat Trout Restoration Project EIR/EIS, and prevents implementation of the project.

2. Issue a temporary stay order, temporary restraining order, and preliminary and permanent injunctions restraining respondent, its agents, employees, officers, and representative

from undertaking any action to implement in any way the Paiute Cutthroat Trout Restoration Project EIR/EIS, pending proper compliance with CEQA;

3. Grant the costs of this suit;

4. Grant attorneys' fees pursuant to § 1021.5 of the Code of Civil Procedure;

5. Consider and grant such other equitable or further relief and remedy as the court deems just and proper.

Date: April 16, 2010

Respectfully submitted,

____

Julia A. Olson
Peter M.K. Frost
Sharon E. Duggan
Attorneys for Petitioners

VERIFICATION

I, Julia A. Olson, declare that,

1. I am an attorney at law duly admitted and licensed to practice before all courts of this State. I have my professional office at 2985 Adams Street, Eugene, OR 97405.

2. I am an attorney of record for Petitioners. None of the Petitioners have their place of business in Lane County in which I have my office, or in Sacramento County where this action is filed. For that reason, I make this verification on their behalf.

3. I have read the foregoing Petition for Writ of Mandate and know the contents thereof; the factual allegations therein are true of my own knowledge, except as to those matters which are therein stated upon my information or belief, and as to those matters I believe them to be true.

4. I declare under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct.

Executed on the 16th day of April, 2010 in Eugene, Oregon.

____
Julia A. Olson

DECLARATION OF SERVICE

I, JULIA A. OLSON, declare:

I am, and was at the time of this service over the age of eighteen and not a party to the above-entitled cause. My business address is 2985 Adams Street, Eugene, OR 97405, and I am a resident of or employed in the County of Lane, Oregon.

On April 16, 2010, I served the attached PETITION FOR WRIT OF MANDATE on the California State Attorney General addressed as follows:

Edmund G. Brown JR.
California State Attorney General
455 Golden Gate Avenue Suite 11000
San Francisco, California 94102

X **BY FIRST CLASS MAIL** by depositing a sealed envelope in the United States Postal Service in the ordinary course of business on the same day it is collected in Eugene, Oregon postage fully prepaid.

____ **BY FACSIMILE MACHINE** by personally transmitting a true copy thereof via a facsimile machine at approximately ____ a.m./p.m. on ____________________.

____ **BY FEDERAL EXPRESS or UNITED PARCEL SERVICE** overnight delivery by personally depositing in a box or other facility regularly maintained by Federal Express or United Parcel Service, an express service carrier, or delivered to a courier or driver authorized by said express service carrier to receive documents.

____ **BY HAND DELIVERY** by personally delivering a true copy thereof in an envelope addressed to the parties identified above at the addresses given for those parties.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that this declaration was executed on April 16, 2010, in Eugene, Oregon.

____
JULIA A. OLSON

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

BOARD ORDER NO. R6T-2010-0015
WDID NO. 6A020405008
NPDES NO. CA0103209

WASTE DISCHARGE REQUIREMENTS AND
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

FOR

CALIFORNIA DEPARTMENT OF FISH AND GAME
PAIUTE CUTTHROAT TROUT RESTORATION PROJECT

Alpine County

The California Regional Water Quality Control Board, Lahontan Region (Water Board) finds:

1. Discharger

   The California Department of Fish and Game (hereinafter Discharger) is responsible for carrying out a variety of fishery management activities. These activities are designed to protect and maintain valuable aquatic ecosystems and sport fisheries. The Discharger is also responsible under State and federal law for the restoration and protection of threatened and endangered species.

2. Project Purpose

   The Discharger, in cooperation with the U.S. Fish and Wildlife Service (USFWS) and the U.S. Department of Agriculture, Humboldt-Toiyabe National Forest (USFS), proposes to use the aquatic pesticide rotenone as part of recovery efforts for Paiute Cutthroat Trout, *Oncorhynchus clarki seleniris*, at Silver King Creek. Paiute Cutthroat Trout is one of the rarest subspecies of trout in North America, indigenous only to the Silver King Creek watershed. Paiute Cutthroat Trout was listed by the USFWS as federally endangered on October 13, 1970 (Federal Register 35:16047) and reclassified as federally threatened on July 16, 1975 (Federal Register 40:29863). Rotenone will be used to eradicate introduced fish species that can out-compete and interbreed with Paiute Cutthroat Trout, from portions of Silver King Creek and associated tributaries, prior to introduction of the native trout.[1]

[1] U.S. Fish and Wildlife Service (USFWS), 2004. Revised Recovery Plan for the Paiute Cutthroat Trout (*Oncoehynchus clarkia seleniris*). Porland, Oregon. Ix + 105 pp.).

The Paiute Cutthroat Trout was successfully reintroduced to upper portions of Silver King Creek, above a natural fish barrier (Llewellyn Falls), following rotenone treatments in 1991, 1992, and 1993. The Discharger is concerned that non-native fish from below this barrier could be introduced by humans into the area where the pure population of Paiute Cutthroat Trout has been reestablished, threatening restoration efforts. The current project would help safeguard the restoration of Paiute Cutthroat Trout by re-introducing the endangered fish to six miles of the main-stem Silver King Creek downstream of Llewellyn Falls, and five miles of associated tributary streams, all of which comprise the historic range of the fish.

This project is identified in the USFWS Revised Recovery Plan for the Paiute Cutthroat Trout (2004)[1] as Priority 1: an action that must be undertaken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

3. <u>Rotenone</u>

Rotenone is a naturally-occurring pesticide found in the roots of certain plants. It is used for insect control and for fisheries management. Rotenone acts by interfering with oxygen use. It is especially toxic to fish because it is readily absorbed through the gills.

The California Department of Pesticide Regulation (DPR) regulates rotenone as a restricted material. Commercial rotenone formulations contain certain “inert” ingredients (solvents, dispersants, emulsifiers, etc.) as well as the active ingredient rotenone.

The active ingredient rotenone and some of the inert ingredients are potentially toxic chemicals. Chemical concentration, duration and route of exposure must all be considered in determining potential risk to non-target organisms. At the concentrations proposed for the Silver King Creek project, the rotenone formulations will be toxic to fish and may be toxic to other gill breathing organisms such as amphibians in aquatic life stages, and aquatic organisms such as invertebrates. There is no evidence of adverse effects to humans or terrestrial wildlife such as deer from incidental contact (for example, through drinking water) with rotenone formulation ingredients applied to surface waters at concentrations typical of fishery management projects.

Under normal field conditions (water temperature greater than 5 °C), when applied to water, rotenone breaks down naturally to non-toxic substances via photooxidation and biodegradation within approximately five days. Inert ingredients in rotenone product formulations are generally more volatile chemically, and are subject to dissipation by volatilization, as well as photooxidation and biodegradation, typically dissipating within two weeks under natural, normal conditions. Both rotenone and inert formulation ingredients will be detoxified by oxidation with potassium permanganate in the project neutralization zone at an accelerated rate of between 15 to 30 minutes. Rotenone binds readily to organic matter in soil where it is held in place and is detoxified by natural processes such as microbial biodegradation. Consequently, rotenone does not persist as a pollutant in groundwater.

4. Project Location

The Discharger will apply rotenone formulation and potassium permanganate into Silver King Creek and associated tributaries between Snodgrass Creek (Silver King Canyon) and Llewellyn Falls (see map, Attachment A). The project area is within the East Fork Carson River Hydrologic Unit, Markleeville Hydrologic Area (Hydrologic Unit #632.10.

5. Basin Plan

In compliance with the Porter-Cologne Water Quality Control Act, the Water Board adopted an updated *Water Quality Control Plan for the Lahontan Region* (Basin Plan) that became effective on March 31, 1995. The Basin Plan incorporates State Water Resources Control Board (State Water Board) plans and policies by reference, contains beneficial use designations and water quality objectives for all waters of the Lahontan Region, and provides a strategy for protecting beneficial uses of surface and ground waters throughout the Lahontan Region. The Basin Plan can be viewed or downloaded on the Internet at http://www.swrcb.ca.gov/rwqcb6/BPlan/BPlan_Index.htm, reviewed at the Water Board office, or purchased at a nominal cost. This permit implements the Basin Plan.

6. Water Board Policy for Discharger Rotenone Use

In 1990, the Regional Board adopted Resolution No. 6-90-43, amending the Basin Plan to permit limited use of the fish toxicant rotenone by the Department of Fish and Game (DFG). The Regional Board and the Discharger entered into a 1990 MOU to facilitate implementation of the amendments. The MOU specifies the detailed information to be provided by the DFG (Discharger) to the Regional Board before undertaking a rotenone application project, and the type of pre- and post-project monitoring to be undertaken. It also sets forth the criteria to be used by the Regional Board Executive Officer in evaluating rotenone application projects. The Basin Plan rotenone policy allows use of rotenone by the DFG (Discharger) for certain specific types of fishery management activities, including restoration or enhancement of threatened or endangered species. Eligibility criteria and conditions are set forth in Chapter 4 of the Basin Plan. For DFG (Discharger) projects meeting the eligibility criteria and conditions, the Basin Plan rotenone policy allows the Water Board the ability to grant the Discharger a variance from meeting Basin Plan water quality objectives (such as the pesticides and toxicity objectives) that would otherwise apply.

DFG (Discharger) Requirements to qualify for a variance to execute rotenone projects are given in Chapter 4 of this Basin Plan, under the section entitled "Rotenone Use in Fisheries Management," and are listed in section 14 of this Order. Water quality objectives for rotenone are in Chapter 3 of this Basin Plan, under the section entitled "Water Quality Objectives for Fisheries Management Activities Using the Fish Toxicant Rotenone." This includes rotenone project specific water quality objectives for color, pesticides, species composition, and toxicity, which are covered in detail in the Monitoring and Reporting Program Section of this Order.

7. Reason for Action

In 2001, the Ninth Circuit Court of Appeals held that point-source discharges of pollutants associated with use of aquatic pesticides in waters of the United States require a National Pollutant Discharge Elimination System (NPDES) permit if the pollutant leaves any residue in the water after its application that would qualify as a chemical waste product. (Headwaters, Inc. v. Talent Irrigation District[2]) In 2005, the Ninth Circuit further held that the use of aquatic pesticides applied intentionally and in accordance with the EPA-approved FIFRA label does not require an NPDES permit if there are no unintended effects associated with the use of the product and no residue remains after the pesticide performs its intended function. (Fairhurst v. Hagener)[3] In 2009, the Sixth Circuit Court of Appeal vacated EPA's regulation exempting pesticides applied in accordance with the FIFRA label from NPDES permit requirements as inconsistent with the Clean Water Act. (National Cotton Council of America v. U.S. E.P.A.)[4] Accordingly, because of the likelihood of unintended effects on macroinvertebrates from the application of rotenone at some or all project locations, the discharge of pollutants associated with the application of rotenone for the Silver King Creek Project requires an NPDES permit.

8. Project Description

The Discharger proposes to apply rotenone in September 2010, with a second treatment planned for August or September 2011. A third treatment could be scheduled for 2012 if it is necessary to ensure complete eradication of non-native fish (for the purposes of this permit, non-native fish refer to any fish species capable of interbreeding with pure Paiute Cutthroat trout (PCT) , or capable of significant competition with PCT for their ecological niche in Silver King Creek).

Under this permit, the Discharger will use CFT Legumine. Use of other formulations is not authorized under this permit.

CFT Legumine: The CFT Legumine™ formulation contains approximately 5% rotenone, 10% methyl pyrrolidone (MP), 60% diethylene glycol monoethyl ether (DEGEE), 17% Fennodefo 99™ (Fennodefo), and 3% other compounds (CDFG, 2007).[5] The two primary inactive carrier components in CFT Legumine™ are MP and DEGEE, which comprise approximately 93 percent of the formulation by weight. Both of these

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[2] Headwaters, Inc. v. Talent Irrigation District, (9th Cir. 2001) 243 F.3d 526.
[3] Fairhurst v. Hagener (9th Cir. 2005) 422 F.3d 1146;
[4] Nat'l Cotton Council of America v. U.S.E.P.A. (6th Cir. 2009) 553 F.3d 927.
[5] California Department of Fish and Game (CDFG). 2007. Lake Davis Northern Pike Eradication EIS/EIR.

chemicals are infinitely soluble in water and have an estimated organic carbon partition coefficient (i.e., the "K_{oc}") of 12, indicating their water solubility and tendency not to adsorb to sediment particles.[4] Based on their low Henry's Law constants, these chemicals do not readily volatilize from surface water, and neither chemical is expected to undergo hydrolysis or direct photolysis.[4]

Aerobic biodegradation would be the most important mechanism for the removal of 1-methyl-2-pyrrolidinone and diethylene glycol monoethyl ether from aquatic systems. The small amount of these chemicals that may volatilize into ambient air would be readily degraded by reaction with photochemically-produced hydroxyl radicals, with an atmospheric half-life of up to 12 hours (NLM, 2006).[6] The Fennodefo 99™ constituent in CFT Legumine facilitates emulsification and dispersion of the otherwise relatively insoluble rotenone. Two classes of constituents, polyethylene glycols (PEGs) and the solvent (alcohol) hexanol, are part of the inert additive Fennodefo 99™ in CFT Legumine, which also contains fatty acid esters. As stated in the "Screening Level Risk Analysis of Previously Unidentified Rotenone Formulation Constituents Associated with the Treatment of Lake Davis," (ENVIRON 2007)[7], the fatty acid ester mixture in Fennodefo 99™ is likely derived from 'tall oil'. Tall oil has been independently reported as a mixture of naturally occurring fatty acids, resins and neutrals that are a by-product of wood pulp, and is a common constituent of soap formulations. The fatty acids in tall oil, principally oleic and linoleic acids, are naturally occurring constituents that are also part of the building blocks that make up fats and oils (triglycerides). Highly unsaturated fatty acids, like linoleic, are considered essential dietary constituents in humans, as they cannot be synthesized. Polyethylene glycols (e.g., propylene glycol) are common ingredients in a variety of consumer products, including soft drink syrups (as an antioxidant), in plasticizers, suntan lotions and antifreeze, among other uses.[4]

The structures and oral toxicities of the two most concentrated constituents in CFT Legumine are summarized below.

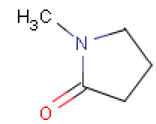
DIETHYLENE GLYCOL MONOETHYL ETHER

- Approximate concentration in formula: 569,000 mg/L
- Toxicology: RAT ORAL LD50: 4,700-9,740 mg/kg.
- Chemical formula: C6H14O3
- Chemical structure: C2H5OCH2CH2OCH2CH2OH

[6] National Library of Medicine (NLM). 2006. *Hazardous Substances Data Bank (HSDB).* Toxicology Data Network (TOXNET), On-Line Database <toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>. National Institutes of Health, Department of Health and Human Services, Bethesda, MD. Reviewed April 2, 2006.

[7] ENVIRON International Corporation. 2007. Screening Level Risk Analysis of Previously Unidentified Rotenone Formulation Constituents Associated with the Treatment of Lake Davis. Prepared by Jeff Fisher for California Department of Fish and Game. September 17, 2007.

1-METHYL-2-PYRROLIDINONE



- Approximate concentration in formula: 90,000 mg/L
- Toxicology: RAT ORAL LD50: 3,914 mg/kg
- Chemical formula: C5H9NO

CFT Legumine™ will be applied to achieve a target concentration of 0.5 to 1.0 mg/L formulation (25 to 50 μg/L rotenone) to all flowing streams. The discharge will take place over a period of 4-6 hours. Rotenone will be applied to streams using drip stations, with hand spraying in backwater areas as necessary. Mini-drips and gel or sand matrices may be used on small seeps if the possibility exists that they provide a sufficient amount of fresh water that fish may use to escape from treated waters.

To contain the effects of rotenone within the project area and prevent a fish kill downstream of the Silver King Canyon, a neutralization station would be operated near Snodgrass Creek. The oxidizing agent potassium permanganate would be applied to Silver King Creek near Snodgrass Creek to neutralize rotenone, approximately 0.75 miles downstream of the lowest falls in Silver King Canyon.

Potassium permanganate would be applied at the resulting concentration of 2 to 4 mg/L. A generator powered auger would be used to apply the granular potassium permanganate. A back-up auger system would be on site in the event of primary auger failure. Potassium permanganate could also be applied from 30 to 55 gallon drums in a liquid form as a backup. The project area extends to the 30-minute travel time mark, which prior experience has shown to be approximately one-quarter to one-half mile downstream of the potassium permanganate infusion station (see Section 12 for a more detailed explanation of the neutralization zone). A 1 mg/L potassium permanganate residual would be maintained at the 30-minute travel time downstream location by increasing or decreasing the amount of permanganate to ensure complete neutralization of rotenone leaving the project area.

Block nets would be placed at selected locations throughout the project area to catch the dead fish. Dead fish collected at the block nets would be buried no closer than 300 feet from the stream and away from known camping areas to minimize bear/human interactions. The USFS would approve all burial sites before any ground disturbing activity occurred. Fish not collected at the block nets would be left in the stream to decompose and become part of the food chain. The Discharger evaluated the potential toxicity of these dead fish to foraging wildlife in its Programmatic Environmental Impact Report, *Rotenone Use for Fisheries Management, July 1994*, and concluded that foraging wildlife will not be adversely affected by consuming these fish.

During the treatment, water quality will be monitored. The monitoring would determine: 1) that effective piscicide concentrations of rotenone are applied; 2) that complete degradation of rotenone has occurred prior to the resumption of public contact; and 3) that rotenone toxicity does not occur outside the project area. An analytical laboratory would analyze water samples for rotenone and rotenolone concentrations as well as for volatile organic compound and semi-volatile organic compound concentrations. Table 1 gives the project treatment chemical concentration ranges and analytical reporting limits.

Table 1. CFT Legumine® Formulation and Potassium Permanganate: Treatment Concentrations and Reporting Limits

Chemical Name	Treatment Concentration (Est.)[1]	Reporting Limit
	ug/l	ug/l
Rotenone (active ingredient)	25.5 - 50.9	2
Rotenolone	3.67 - 7.34	2
1-Methyl-2-pyrrolidinone (Methyl pyrrolidone)	49.5 - 98.9	5
Diethylene glycol monoethyl ether (Diethylene glycol ethyl ether)	305 - 610	5
1-Hexanol	2.12 - 4.14	5
sec-Butylbenzene	0.00195 - 0.0039	0.3
1-Butylbenzene (n-Butylbenzene)	0.0120 - 0.0239	0.3
1,4-diethylbenzene	0.25 - 0.50	5
1,2,4-Trimethylbenzene	0.0174 - 0.0348	0.2
1,3,5-Trimethylbenzene (mesitylene)	0.002 - 0.004	0.1
1,2,4,5-tetramethylbenzene	0.201 - 0.402	5
Toluene	0.111 - 0.222	0.5
4-Isopropyltoluene (isopropyltoluene)	0.00255 - 0.0051	0.3
Methylnaphthalene	0.07 - 0.14	5
Naphthalene	0.127 - 0.253	5
Potassium Permanganate	2.0-4.0 mg/L	0.00288 mg/L

[1] Range corresponds to 0.5 to 1.0 mg/L rate of CFT-Legumine product application

9. Project Boundaries

The Basin Plan defines the project boundaries for rotenone projects as encompassing the treatment area, the detoxification area, and the area downstream of the detoxification station at Snodgrass Creek, up to a thirty-minute in-stream travel time. The project boundaries are determined in the field based on stream flow measurements immediately prior to treatment.

10. Proposition 65 Considerations

Four inert ingredients present in one or both proposed rotenone formulations (N-methyl-2-pyrrolidone, toluene, trichloroethylene, and naphthalene) are on the Proposition 65 list of chemicals known to the state of California to cause cancer or reproductive toxicity.

The Proposition 65 statute is contained in California Health and Safety Code sections 25249.5-25249.13. Proposition 65 prohibits the discharge of chemicals known to cause cancer or reproductive toxicity. The California Department of Public Health is the state agency responsible for enforcing Proposition 65.

Section 25249.5 states that “No person in the course of doing business shall knowingly discharge or release a chemical known to the state to cause cancer or reproductive toxicity into water or onto or into land where such chemical passes or probably will pass into any source of drinking water.” Proposition 65 defines “person” for purposes of its prohibitions as “an individual, trust, firm, joint stock company, corporation, company, partnership, limited liability company, and association.” (Section 25249.11, subd. (a).) Proposition 65 specifically states that “person in the course of doing business” does not include “the state or any department or agency thereof or the federal government or any department or agency thereof.” (Section 25249.11, subd. (b).) Thus, because neither the state government nor the federal government nor their respective agencies and departments are “persons” or “persons in the course of doing business” within the meaning of Proposition 65, the prohibition in Section 25249.5 does not apply to the Discharger.

11. Impacts to Non-target Aquatic Life—Benthic Macroinvertebrates

Rotenone treatment is expected to have short-term (yearly) effects on benthic macroinvertebrate communities (invertebrates are expected to repopulate treated areas following treatment and beneficial uses must be restored within two years of the final treatment). The Discharger conducted benthic macroinvertebrate monitoring studies before, during, and for three consecutive years following rotenone treatments that occurred in portions of the Silver King Creek basin in 1991 through 1993. The Discharger also conducted a study of rotenone impacts on macroinvertebrates in Silver Creek (Mono County), which was treated for three years from 1994 to 1996. (Trumbo et al., 2000a[8] and 2000b[9]). These studies] suggested that rotenone may have short-term impacts (yearly) to sensitive aquatic invertebrates . . .” Based on those studies and the

[8] Trumbo, J., S. Siepmann, and B. Finlayson. 2000a. Impacts of rotenone on benthic macroinvertebrate populations in Silver King Creek, 1990 through 1996. Office of Spill Prevention and Response, Administrative Report 00-5, March 2000. Pesticide Investigations Unit, Office of Spill Prevention and Response, California Department of Fish and Game. 40 p.

[9] Trumbo, J., S. Siepmann, and B. Finlayson. 2000b. Impacts of rotenone on benthic macroinvertebrate populations in Silver Creek, 1994 through 1998. Office of Spill Prevention and Response, Administrative Report 00-7, December 2000. Pesticide Investigations Unit, Office of Spill Prevention and Response, California Department of Fish and Game. 37 p.

metrics evaluated, the Discharger concluded that the data do not suggest any significant long-term (greater than one year, up to five years, the study period) impacts to invertebrates lasting beyond the study periods. Vinson and Vinson (2007)[10] could not find long term impacts of rotenone treatments to aquatic macroinvertebrates in the dataset they reviewed for the Silver King Creek basin.

The Discharger submitted the Silver King Macroinvertebrate Monitoring Plan, August 2007-2015, including plans for pre- and post-project macroinvertebrate surveys and statistical analysis. This monitoring plan incorporates recommendations by Vinson. The Discharger will implement in the Monitoring and Reporting Program as part of the current project.

At this time, no macroinvertebrate species have been identified that are strictly endemic to the Silver King Creek basin. However, several studies suggest that springs are likely habitat for rare and endemic species, such as spring snails, which have not been detected in macroinvertebrate surveys. Mitigation measures to protect potential rare and endemic species include using the lowest concentration of rotenone formulation yet still maintaining efficacy of treatment, not treating headwater tributaries that are deemed fishless at time of treatment, and not treating springs and seeps that are determined to be fishless. Protocol for and protection of potential rare and/or endemic species involves: surveying springs and seeps in the project area for non-native fish, with subsequent flagging and mapping of fishless refugia, which will not be treated with rotenone (see Monitoring and Reporting Program for a more detailed description). Additionally, since treatment will occur in late summer/early fall, springs and ephemeral surface waters dry at the time of treatment will not be treated.

12. Impacts to Non-target Aquatic Life—Amphibians

Amphibians in the terrestrial life stage should not be affected by the rotenone treatment. However, amphibians in the gill breathing life stages are susceptible, if present.

Sierra Nevada yellow-legged frogs (formerly known as mountain yellow-legged frog) (*Rana sierrae,* formerly *muscosa*) are known to inhabit portions of the Silver King Creek basin. No Yosemite toads (*Bufo canorus*) have been found in the basin. Silver King is at the northern extent of the range of the Yosemite toad. Some toads were thought to be hybrids, and it is now thought that these were western toads (*Bufo boreas*). Sierra Nevada yellow-legged frogs and Yosemite toads are candidates for listing under the federal Endangered Species Act. The Discharger recently completed six years of amphibian surveys within the project area and nearby upstream areas. Although Sierra Nevada yellow-legged frogs have been found in certain areas upstream of the project area (Upper Fish Valley and Fly Valley Creek), none have been observed in the project

[10] M. R. and D.K. Vinson. 2007. An analysis of the effects of rotenone on aquatic invertebrate assemblages in the Silver King Creek Basin, California. Moonlight Limnology. Report Prepared for the Humboldt-Toiyabe National Forest. 255 pp.

area. A few Western toad/Yosemite toad adult and terrestrial sub-adult hybrids were observed within the project area. Discharger biologists determined that during the August 2004 and 2005 surveys, tadpoles within the project area had already metamorphosed into terrestrial lifestages due to an early spring/summer and low water year.

The Discharger will conduct additional amphibian surveys immediately before treatment, according to protocols described in the Monitoring and Reporting Program. If adult or tadpole life stages of any threatened, endangered, sensitive, candidate or rare amphibians are found during pre-project surveys, they will be captured by net and relocated out of the project area to suitable nearby habitat.

13. Past Discharger Rotenone Projects in the Lahontan Region

The Discharger has completed several rotenone projects in the Lahontan Region since the late 1980s. Those projects included treatments of portions of the Upper Truckee River (Alpine County), Mill Creek (Mono County), Silver Creek (Mono County) Wolf Creek (Mono County), and the 1991-1993 treatments in upper portions of the Silver King Creek drainage for Paiute Cutthroat Trout restoration.

The Water Board waived waste discharge requirements for those projects. Following the Ninth Circuit Court of Appeal's decisions in Headwaters, Inc. v. Talent Irrigation District and Fairhurst v. Hagener, and the Sixth Circuit Court of Appeal' decision in National Cotton Council of America v. U.S. E.P.A., NPDES permits are required for the discharge of aquatic pesticides to waters of the U.S. if any residue remains after the pesticide has performed its intended function or there are any unintended effects of the use of the pesticide. Because of the likelihood of unintended effects on macroinvertebrates from the application of rotenone throughout the project area, there is no basis to waive waste discharge requirements for this rotenone treatment project.

On July 6, 2005, the Discharger received an NPDES permit from the State Water Board (Order No. 2005-0010-DWQ) for a rotenone treatment project in the Silver King Creek drainage for Paiute Cutthroat Trout restoration. Californians for Alternatives to Toxics and several other organizations and individuals filed suit in both state and federal court seeking to have the NPDES permit vacated and to enjoin the Discharger (in the state case) and USFS (in the federal case) from engaging in any acts in reliance on that permit.

The state case was filed in the Sacramento County Superior Court and the petitioners sought a writ of mandate (Case No. 050501160). On September 12, 2005, the Court denied the petitioners' application for a temporary restraining order. In so doing, the Court found a "strong and legitimate interest in preserving the Paiute cutthroat trout." The petitioners subsequently dismissed the state case after the federal district court issued an injunction barring the project.

The federal case was filed in the United States District Court, Eastern District of California (Case No. Civ. S-05-1633 FCD KJM). The district court issued a temporary restraining order on August 31, 2005 and a preliminary injunction on September 1, 2005, prohibiting USFS from conducting or allowing to be conducted any portion of the Paiute cutthroat trout restoration project. The Court found both that the plaintiffs demonstrated a strong likelihood of success on their claim that macroinvertebrates would be irreparably harmed and that they raised serious questions as to the adequacy of the USFS's Environmental Assessment and as to whether USFS should have conducted an Environmental Impact Statement.

On September 30, 2005, the Discharger requested that the State Water Board rescind the NPDES permit for the project. On October 20, 2005, the State Water Board rescinded the NPDES permit.

The Discharger has historically conducted several rotenone treatments in the Lahontan Region. These are detailed in the environmental document (USFWS/CDFG, 2010[11]). Lessons learned from these earlier treatments, involving both success and failure, were used to develop improved field methods using state-of-the-art equipment and a more robust command and control structure. The current project uses a precision dry-chemical permanganate dispensing auger that is inherently more reliable, with less potential for breakdown, error, freezing, etc., than the former system of dispensing permanganate solutions. The current command and control structure includes real-time field permanganate testing at the two-and thirty-minute stream travel times below the neutralization station, with immediate communication between neutralization station staff and the samplers. These three sites in the neutralization area will be attended by Discharger staff continuously, day and night, during project implementation.

[11] USFWS/CDFG. 2010. Final EIS/EIR, Paiute Cutthroat Trout Recovery Project.

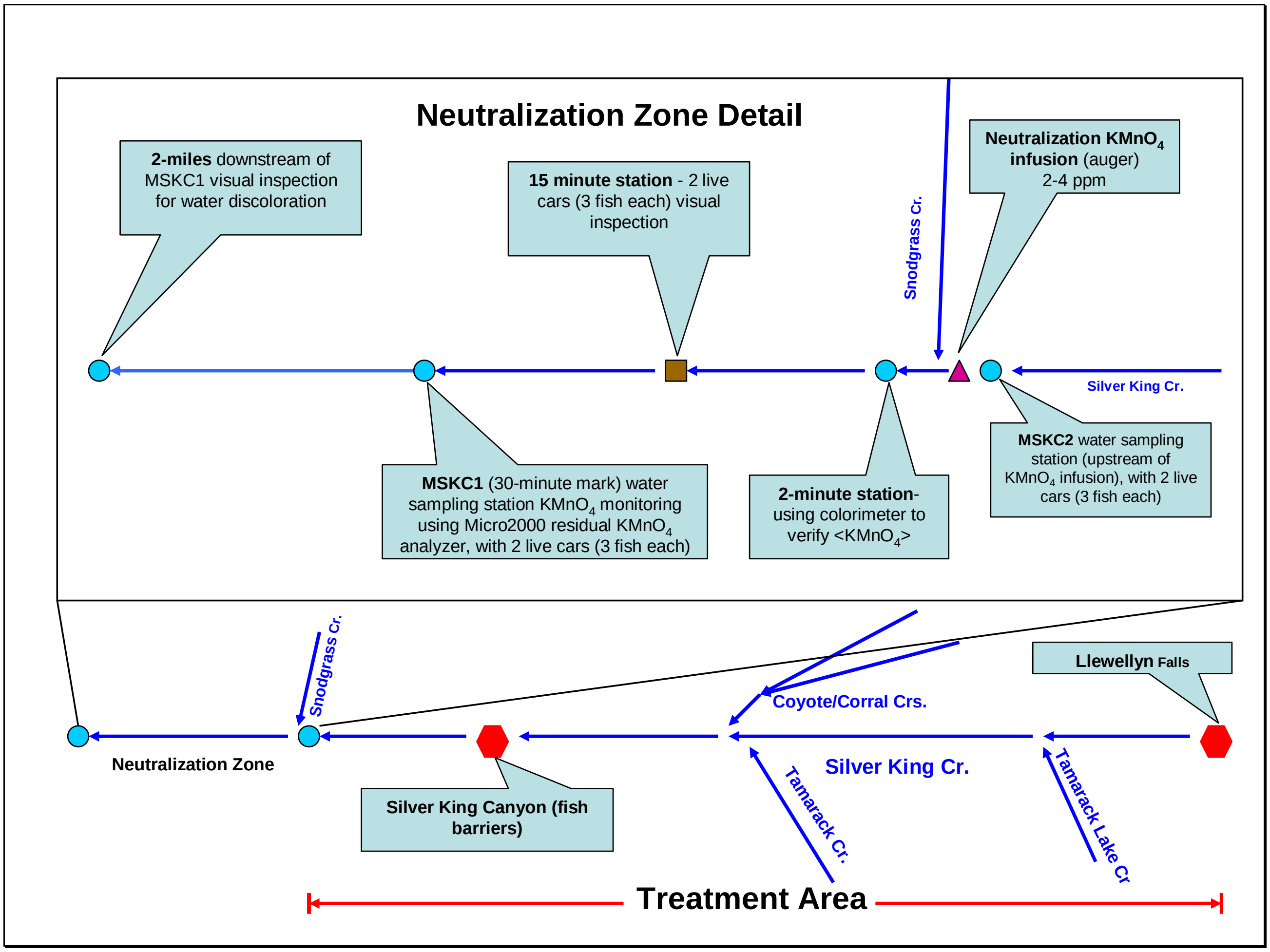


Figure 1: Silver King Creek Paiute Cutthroat Trout Restoration Project Treatment Area with Neutralization Zone Detail

Figure 1 depicts the chain of components in the neutralization system along Silver King Creek. From right-to-left, the upstream sampling station (MSKC2) with the first trout toxicity test station; the potassium permanganate (KMnO4) Neutralization infusion station; the first KMnO4 sampling station at the two-minute stream travel time mark; the second trout toxicity test station at the 15-minute mark; the downstream sampling station (MSKC1) including the third trout toxicity test station located at the 30-minute stream travel time below the KMnO4 infusion station; and the water color inspection station two miles downstream of MSKC1. The lower project boundary is at MSKC1, which also serves as the point-of-compliance for rotenone and other constituents in the product formulation. Two miles below MSKC1 is the point-of-compliance for the color water quality objective, as required by the Basin Plan, Chapter 3, "Water Quality Objectives for Fisheries Management Activities Using the Fish Toxicant Rotenone" section.

14. Project Information Submitted by Discharger Meets Requirements for Variance

Chapter 4 of the Basin Plan, under the section entitled "Rotenone Use in Fisheries Management requires that rotenone projects meet the following conditions:

1. The purpose of the proposed project must be one of the following:

   (a) The restoration and protection of threatened or endangered species.

   (b) The control of fish diseases where the failure to treat could result in significant damage to fisheries resources or aquatic habitat.

   (c) The elimination of prohibited species (as defined in CA Fish and Game Code section 2118), where competition or predation from such species threatens valuable sport fish or native fish populations, or populations of other valuable organisms.

   The Discharger's proposed project is eligible by virtue of the above condition 1.(a) for restoration of a threatened species (Paiute Cutthroat trout).

2. Chemical residues resulting from rotenone treatment must not exceed the narrative or numerical limitations established in Chapter 3 of this Basin Plan, under the section entitled "Water Quality Objectives For Fisheries Management Activities Using the Fish Toxicant Rotenone."

   The Discharger has provided detailed plans for effective and complete neutralization of rotenone and formulation products using potassium permanganate, refined by historic rotenone treatment experience (see Finding 13). Additionally the Discharger must execute a comprehensive chemical monitoring plan for compliance.

3. Within two years of the last treatment for a specific project, a fisheries biologist or related specialist from the DFG (Discharger) must assess the restoration of applicable beneficial uses to the treated waters, and certify in writing that those beneficial uses have been restored. A project will be considered to have been completed upon written acceptance by the Regional Board's Executive Officer of such certification.

This Order requires that the DFG (Discharger) perform an assessment of restoration of applicable beneficial uses of treated water and certify in writing that those beneficial uses have been restored.

4. Based on information and project plans submitted by the DFG (Discharger), the Regional Board's Executive Officer must determine that the proposed project will meet all applicable provisions (including subsequent amendments or revisions) of this Basin Plan, the DFG's (Dischargers) Environmental Impact Report *Rotenone Use for Fisheries Management* (1994) regarding rotenone use. Whenever the language contained in the above-mentioned documents may overlap, the requirements that will provide the most restrictive protection of water quality shall apply. Furthermore, the Regional Board's Executive Officer must determine that the project meets all of the following additional criteria:

(a) The limitations on chemical residue levels referenced in Condition #2 (above) can be met.

See explanation below Condition #2 (above).

(b) The planned treatment protocol will result in the minimum discharge of chemical substances that can reasonably be expected for an effective treatment.

The Discharger is using a rotenone formulation containing no harmful synergists, such as piperonyl butoxide, with the least concentration of inert ingredients of any commercially available. The application concentrations used are the least that is possible, and still meet project objectives.

(c) Chemical transport, spill contingency plans, and application methods will adequately provide for protection of water quality.

The Discharger is required under this Order to provide adequate, detailed spill contingency plans and chemical handling and disposal plans

(d) Suitable measures will be taken to notify the public, and potentially affected residents.

The Discharger has detailed public notification requirements in the environmental document (USFWS/CDFG. 2010), and is required under this Order to carry out those requirements.

(e) Suitable measures will be taken to identify potentially affected sources of potable surface and ground water intakes, and to provide potable drinking water where necessary.

This does not apply to this project—no water intakes exist within or near the project area.

(f) A suitable monitoring program will be followed to assess the effects of treatment on surface and ground waters, and on bottom sediments.

The attached Monitoring and Reporting Program covers surface water monitoring. Monitoring of ground waters, and on bottom sediments are not a concern for the reasons given above.

(g) For each project, the DFG (Discharger) has satisfied the requirements of the California Environmental Quality Act (CEQA).

The Dischager has provided an adequate, certified environmental document (USFWS/CDFG. 2010).

(h) The chemical composition of the rotenone formulation has not changed significantly (based on analytical chemical scans to be performed by the DFG (Discharger) on each formulation lot to be used) in such a way that potential hazards may be present which have not been addressed.

The Discharger is required under this Order to provide up-to-date and detailed lot analysis of the rotenone formulation before project implementation.

(i) Plans for disposal of dead fish are adequate to protect water quality.

This Order requires proper disposal of dead fish following a protocol that is adequate to protect water quality.

The project meets the Basin Plan eligibility requirements, as it is a restoration project for a federally threatened species, the Paiute Cutthroat Trout.

The Water Board has considered this information submitted by the Discharger and determined that this project meets Basin Plan conditions and eligibility criteria for Discharger rotenone projects. On that basis, the project qualifies for the variance, established in the Basin Plan, from meeting water quality objectives that would otherwise apply. The project is subject, however, to specific water quality objectives for rotenone use contained in the Basin Plan, and to numeric criteria for priority pollutants contained in the California Toxics Rule, unless the project qualifies for an exception.

15. Consideration of Alternatives to Chemical Treatment

The Discharger has considered alternatives to chemical treatment in the environmental document, and determined that rotenone treatment is the superior option to ensure the complete eradication of non-native fish necessary to reestablish the Paiute Cutthroat Trout for this project. The Water Board has reviewed the alternatives, and concurs that there is currently no other effective option available in California at this time.

16. Beneficial Uses of Silver King Creek

The beneficial uses of Silver King Creek as set forth and defined in the Basin Plan are: Municipal and Domestic Supply, Agricultural Supply; Groundwater Recharge; Water Contact Recreation; Non-contact Recreation; Commercial and Sport Fishing; Cold Freshwater Habitat, Wildlife Habitat; Rare, Threatened or Endangered Species; and Spawning, Reproduction, and Development.

17. Effluent Limitations

NPDES permits for discharges to surface waters must meet all applicable provisions of sections 301 and 402 of the CWA. These provisions require controls that use best available technology economically achievable (BAT), best conventional pollutant control technology (BCT), and any more stringent controls necessary to reduce pollutant discharges and meet water quality standards.

Pursuant to section 122.44(k)(3) of Title 40 of the Code of Federal Regulations (CFR), Best Management Practices (BMP) may be required in NPDES permits in lieu of numeric effluent limits, to control or abate the discharge of pollutants, when numeric effluent limits are infeasible. Numeric effluent limits for pollutant discharges associated with the application of rotenone formulation and potassium permanganate neutralizing agent are not feasible, because in this case there is no definable “effluent” upon which limits can be placed. Rotenone and potassium permanganate are commercial products of formulated chemical composition, rather than an effluent waste stream from a controllable process or activity.

After being mixed with receiving waters and achieving their intended effect, excess and residual amounts of these materials and their breakdown products may be considered pollutants. This permit requires that the Discharger implement BMPs to control or abate pollutants in the receiving water, and comply with numeric receiving water limitations. Those BMPs constitute BAT and BCT and will be implemented to minimize the area and duration of impacts caused by the discharge of aquatic pesticides in the treatment area.

This approach will allow for restoration of water quality and the long-term protection of beneficial uses of the receiving water following completion of a treatment event.

18. California Toxics Rule

The U.S. Environmental Protection Agency (USEPA) promulgated the California Toxics Rule (CTR, Code of Federal Regulations, Title 40, Part 131.38), establishing numeric criteria for priority toxic pollutants for the State of California. The State Board adopted the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (State Implementation Policy), which establishes procedures for implementing water quality standards in NPDES permits. Section 5.3.1 of the State Implementation Policy allows the Water Board to grant short-term or seasonal categorical exceptions from meeting the CTR priority pollutant criteria/objectives for:

“resource or pest management (i.e., vector or weed control, pest eradication, or fishery management) conducted by public entities or mutual water companies to fulfill statutory requirements, including, but not limited to, those in the California Fish and Game, Food and Agriculture, Health and Safety, and Harbors and Navigation codes.”

The Discharger qualifies for this exemption, as it is a public entity (specifically the Department of Fish and Game), engaged in fulfilling a statutory requirement to restore Federally-threatened species, such as Paiute Cutthroat trout.

Among other requirements, entities seeking an exception to complying with water quality standards for priority pollutants must submit California Environmental Quality Act (CEQA, Public Resources Code Section 21000, et seq.) documents.

The Discharger prepared an EIS/EIR in compliance with CEQA. The Silver King Creek rotenone project meets the qualifications for a categorical exception from meeting CTR priority pollutant criteria/objectives, and an exception is granted in the provisions of this permit. Therefore, effluent and receiving water monitoring for priority pollutants, as described in the State Implementation Policy, is not required for this project.

19. California Environmental Quality Act (CEQA) Compliance

This action to adopt an NPDES permit is exempt from the provisions of the California Environmental Quality Act (Public Resources Code Section 21000, et seq.) in accordance with Section 13389 of the California Water Code.

Though the Water Board’s adoption of this NPDES permit is exempt from CEQA, pursuant to California Code of Regulations, title 14, section 15096, subdivision (g)(2), the Water Board is nonetheless proceeding as a CEQA Responsible Agency. The Water Board has evaluated the Paiute Cutthroat Trout Restoration Project EIS/EIR for potentially significant impacts to water quality, concurs with the EIS/EIR’s findings regarding significant water quality-related effects, and finds that there are no additional feasible, less-damaging alternatives or mitigation measures that would accomplish the project's objectives except for rotenone application.

While adoption of this NPDES permit by the Water Board is exempt from CEQA, Section 5.3 of the State Implementation Policy (SIP) requires public entities requesting exceptions from meeting CTR priority pollutant criteria/objectives to submit CEQA documentation to the Water Board for approval. In 1994, the Discharger completed a Programmatic Environmental Impact Report entitled *Rotenone Use for Fisheries Management, July 1994*. In addition, in 2009 the US Fish and Wildlife Service and the Discharger completed a joint NEPA/CEQA environmental document "Paiute Cutthroat Trout Recovery Project, Silver King Creek, Humboldt-Toiyabe National Forest, Alpine County, California," and filed a CEQA Notice of Determination for the project with the Governor's Office of Planning and Research on March 17, 2010 This CEQA documentation has been submitted to the Water Board and Water Board hereby finds the Discharger in compliance with SIP, Section 5.3 CEQA requirements.

California Code of Regulations, title 14, section 15096, subdivision (g)(2) states: "When an EIR has been prepared for a project, the Responsible Agency shall not approve the project as proposed if the agency finds any feasible alternative or feasible mitigation measures within its powers that would substantially lessen or avoid any significant effect the project would have on the environment."

California Code of Regulations, title 14, section 15096, subdivision (h) states: "The Responsible Agency shall make the findings required by Section 15091 for each significant effect of the project and shall make the findings in Section 15093 if necessary."

The Water Board's approval of this project will result in the following potentially significant and unavoidable impacts pursuant to California Code of Regulations, title 14, section 15091, subdivision (a), even with the implementation of all feasible mitigation:

(1) The proposed Action could result in the loss of individual benthic macroinvertebrate taxa, potentially including rare (unquantified) and/or unidentified species endemic to Silver King Creek.

(2) The proposed Action will result in temporary changes in species composition in non-target aquatic invertebrate communities.

Pursuant to California Code of Regulations, title 14, section 15093, subdivision (a)(1), "changes or alterations have been required in, or incorporated into, the project which avoid or substantially lessen the significant environmental effect as identified in the final EIR" that apply to both impacts (1) and (2) above include:

- Removal of Tamarack Lake from the project area after extensive monitoring efforts during the Summer of 2009 that determined the lake to be fishless.

- Use CFT Legumine™ (liquid rotenone), a formulation that does not contain *pipeornyl butoxide* (pbo) a substance that has been shown to increase toxicity to aquatic macroinvertebrates. In addition, this formulation has been shown not to have adverse human health concerns.

- Use the lowest concentration of formulated rotenone, yet still maintain efficacy to reduce impacts non-target aquatic organisms.

- The Discharger will conduct pre-project amphibian surveys, and if any amphibians are encountered, the Discharger will relocate them to outside the project treatment area.

- The Discharger will identify fishless areas (tributary headwaters, springs, and seeps) that will not provide refugia for fish seeking to escape the chemical treatment and can be maintained in a fishless condition. These areas will serve as aquatic macroinvertebrate refugia for post-project recolonization. These designated non-treatment areas will be mapped (GPS) and flagged. These areas will not be chemically treated.

Pursuant to California Code of Regulations title 14, section 15093, subdivision (a)(1), a change or alteration required in, or incorporated into, the project to avoid or substantially lessen the significant environmental effect of impact (1) above only, is the identification by the Discharger of fishless tributary headwaters, springs, and seeps that will not provide refugia for fish seeking to escape the chemical treatment and can be maintained in a fishless condition. These designated non-treatment areas will be mapped (GPS), flagged, and will not be chemically treated. These areas will additionally serve as aquatic macroinvertebrate refugia for post-project recolonization. Additionally, the Water Board has imposed application specifications that prohibit the Discharger from applying rotenone when water temperatures are less than 5°C, to assure the effectiveness of treatment.

As a Responsible Agency, the Water Board pursuant to the California Code of Regulations, title 14, section 15093, subdivision (a)(3), the Water Board considers these potentially unavoidable adverse environmental effects. The adverse effects are "acceptable" because of the economic, legal, social, technological or other benefits of the project. These benefits include:

- Restoration of the native species Paiute Cutthroat Trout, representing heritage resources that future generations should be able to enjoy. These species of fish are of ecological, educational, historical, recreational, esthetic, economic, and scientific value to the people of this state, and the conservation, protection, and enhancement of these species and their habitat is of statewide concern.

- More than doubling the existing habitat for, and re-establishing Paiute cutthroat trout to its entire historic range. The reach of Silver King Creek between Llewellyn Falls and Silver King Canyon that will be recovered has more complexity and diversity than the existing habitat occupied by the Paiute cutthroat trout. The population estimates for the existing non-native hybridized populations downstream of Llewellyn Falls are approximately double that of the Paiute populations upstream of Llewellyn Falls.

- Removal of the principal threat to the continued existence of Paiute cutthroat trout by the eliminating sources of hybridized fish in close proximity to existing populations of the sub-species ,which will effectively isolate the species in the Silver King Creek basin.

- Reduced threats from genetic bottlenecking and stochastic environmental events (e.g., forest fires and floods) through the expansion of habitat and connectivity with other populations within the Silver King Watershed.

- Accomplishing a critical and necessary step leading to the goal of eventually delisting the Paiute cutthroat trout from the federal Threatened Species List.

- Maintenance and expansion of fishless habitats in headwater habitats and lakes within the Silver King Creek watershed for the benefits of sensitive native amphibians and invertebrates.

- Restoration of native species in the Carson-Iceberg Wilderness is a benefit and the enhancement of the genetic diversity of the Paiute cutthroat trout will allow for less management by the Discharger, and would preserve and enhance the long-term wilderness and ecological values.

The Water Board finds that the biological and ecological, social, and other benefits of the project outweighs the significant and unavoidable adverse impacts of the project and is therefore "acceptable", pursuant to California Code of Regulations, title 14, section 15093, and consistent with the Discharger's statement of overriding considerations (CDFG, 2010[12]).

20. Nondegradation/Antidegradation

The Water Board has made certain findings consistent with State Water Resources Control Board (State Board) Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California", and with the Federal Antidegradation Policy contained in 40 CFR 131.12, that allowing the temporary degradation of water quality, which will result from implementation of the proposed project, is necessary to

[12] CDFG, 2010. CEQA Findings of Fact And Statement of Overriding Considerations of the California Department of Fish And Game for the Paiute Cutthroat Trout Restoration Project, March 8, 2010.

protect and maintain important economic and social resources. Specifically, these resources are valuable fisheries and aquatic habitats within the Lahontan Region. Protection of these resources, and establishment of threatened and endangered species, is consistent with maximum benefit to the people of the state. The Basin Plan states:

> *The temporary deterioration of water quality due to the use of rotenone by the DFG is justifiable in certain situations. The Water Board recognizes that the State and federal Endangered Species Acts require the restoration and preservation of threatened and endangered species* . . . *These resources are of important economic and social value to the people of the State, and the transitory degradation of water quality and short-term impairment of beneficial uses that would result from rotenone application is therefore justified provided suitable measures are taken to protect water quality within and downstream of the project area.*

Therefore, this Permit is consistent with the State non-degradation and federal anti-degradation policies.

21. Species Composition Considerations and Non-degradation/Anti-degradation

The Basin Plan rotenone policy requires that, within two years following the last treatment for a specific project, a fisheries biologist or related specialist from the Discharger must assess the condition of the treated waters, and certify in writing whether all applicable beneficial uses have been restored. Pursuant to the Basin Plan, that assessment must consider the condition of fish and invertebrate populations in the affected waters.

The Basin Plan water quality objectives for rotenone include a species composition objective that states:

> “Where species composition objectives are established for specific water bodies or hydrologic units, the established objective(s) shall be met for all non-target aquatic organisms within one year following rotenone treatment [or within one year following the final rotenone application for multi-year projects].”
>
> And:
>
> “Threatened or endangered aquatic populations (e.g., invertebrates, amphibians) shall not be adversely affected. The Discharger shall conduct pre-project monitoring to prevent rotenone application where threatened or endangered species may be adversely impacted.

I. No species composition objective has been established in the Basin Plan specifically for Silver King Creek or for the East Fork Carson River Hydrologic Unit.

However, Basin Plan anti-degradation provisions require protecting non-target aquatic organisms so that aquatic species composition is not degraded over the long-term. the Discharger has included measures to protect threatened and endangered species, which may be potentially present, in compliance with the Basin Plan requirement (see Section 11 and Monitoring and Reporting Program protocol “Identification and Protection of Sensitive Macroinvertebrate Refugia Habitats” for more information).

The Discharger will also conduct benthic macroinvertebrate monitoring to evaluate the assertion that rotenone treatment will not adversely affect populations of non-target aquatic organisms and beneficial uses of water over the long-term, and to better establish the duration of short-term impacts.

22. Notification of Interested Parties

The Water Board has notified interested agencies and persons of its intent to adopt an NPDES permit for the discharge, and has provided them with an opportunity to submit comments.

23. Consideration of Public Comments

The Water Board, in a public meeting, heard and considered all comments pertaining to the discharge.

24. NPDES Permit

This Order shall serve as an NPDES permit pursuant to section 402 of the Clean Water Act and shall take effect upon the date of adoption.

IT IS HEREBY ORDERED that:

I. DISCHARGE SPECIFICATIONS

A. Receiving Water Limitations

The Discharger must comply with the following receiving water limitations. The discharge of rotenone formulation and potassium permanganate to surface waters shall not cause, or contribute to, violation of the following water quality objectives contained in the Basin Plan rotenone policy:

1. Color

The characteristic purple discoloration resulting from the discharge of potassium permanganate shall not be discernible more than two miles downstream of project boundaries at any time. Twenty-four hours after shutdown of the detoxification operation, no color alteration(s) resulting from the discharge of potassium permanganate shall be discernible within or downstream of project boundaries.

2. Pesticides

   a. The concentration of naphthalene outside of project boundaries shall not exceed 25 µg/L at any time.

   b. The concentration of rotenone, rotenolone, toluene, methyl pyrrolidone, diethylene glycol ethyl ether, 1-hexanol, sec-butylbenzene, n-butylbenzene, 1,4-diethylbenzene, 1,2,4-trimethylbenzene, mesitylene, 1,2,4,5-tetramethylbenzene, isopropyltoluene, and ethylnaphthalene outside of project boundaries shall not exceed the reporting limits[13] for these respective compounds at any time.

   c. After a two-week period has elapsed from the date that rotenone application was completed, no chemical residues resulting from the treatment shall be present at detectable levels within or downstream of project boundaries.

   d. No chemical residues resulting from rotenone treatments shall exceed detection levels in ground water at any time.

3. Toxicity

   Chemical residues resulting from rotenone treatment must not exceed the limitations listed above for pesticides.

B. Application Specifications

1. The Discharger must use only the rotenone formulations which it has previously identified and characterized for this project (specifically, CFT Legumine™). At least 21 calendar days before the implementation of the proposed project, the Discharger shall provide Water Board Executive Officer with the name, manufacturer and lot number of the commercial rotenone formulation to be used, as well as the results of organic analytical analyses for each lot of formulation to be used, performed by the DFG Water Pollution Control Laboratory or other laboratory certified in appropriate organic analyses, if applicable. Analytes shall include, at a minimum, rotenone, rotenolone, volatile organics, and semivolatile compounds. The chemical composition of the rotenone formulation must not be significantly changed, in such a way that potential hazards may be present which have not been addressed. Prior to the implementation of the proposed project,

[13] "Reporting Limit" is defined as the minimum level that can be routinely detected using laboratory methodology and equipment common to current practices of the analytical laboratory community, and found acceptable to the regulatory community.

the Executive Officer will make a determination on whether the formulation has significantly changed or not, as it relates to anticipated adverse environmental effects.

2. Rotenone applications must be made in accordance with label specifications. Consistent with label detoxification requirements, formula concentrations may not exceed one part per million (50 parts per billion rotenone concentration).

3. Applications must be supervised by a licensed applicator in accordance with regulations of the Department of Pesticide Regulation.

4. Applications of rotenone and potassium permanganate must be made in compliance with the Basin Plan and the project EIS/EIR.

5. The Discharger must implement the Spill Contingency plan submitted with the 2010 Rotenone Application.

6. The Discharger must conduct macroinvertebrate surveys according to protocols described in the Monitoring and Reporting Program, including pre- and post-application surveys.

7. The Discharger must conduct thorough surveys of springs, seeps, and headwaters in the project area no more than two weeks prior to treatment according to the protocol given in the Monitoring and Reporting Program. The Discharger shall not treat any of these sites they determine to be fishless (where insufficient habitat or water volume exists at time of treatment to contain a fish). The Discharger shall communicate these locations to applicators through flagging and/or mapping. The Discharger shall submit a draft map of no treatment areas to the Water Board one day prior to treatment. **By November 1** of each year of any chemical treatment, the Discharger shall submit a final map certifying areas that received no rotenone application.

8. The Discharger must conduct additional amphibian surveys immediately before treatment, according to protocols described in the Monitoring and Reporting Program. If adult or tadpole life stages of any threatened, endangered, sensitive, candidate or rare amphibians are found during pre-project surveys, they will be captured by net and relocated out of the project area to suitable nearby habitat.

9. The Discharger is prohibited from applying rotenone treatments when water temperatures are below 5°C, to assure the effectiveness of treatment.

C. General Requirements

1. During Project implementation, the Discharger is required to implement Best Management Practices. Required BMPs include, but are not limited to: applying rotenone in accordance with label instructions by a licensed applicator; using potassium permanganate to detoxify rotenone before it escapes the treatment area; applying the minimum concentration of chemicals determined necessary to achieve an effective rotenone treatment; maintaining and implementing a suitable spill prevention and response plan; applying rotenone only when ambient water temperatures are sufficiently high to promote its rapid post-treatment breakdown; and conducting water quality monitoring inside and outside the treatment area.

2. All project operations must be conducted consistent with plans and management practices contained in documents submitted by the Discharger prior to the adoption of this permit, including the Discharger's EIS/EIR for the project.

3. The Discharger must provide the public with adequate notice of the treatments, and post signs in the project area prior to treatment with appropriate warnings against public contact with water and fish while chemical residues are present, will bury the dead fish, and shall direct wilderness users to alternative potable water sources as appropriate.

4. Mechanical disturbance of soils (for example, to bury fish or construct earthen spill containment berms) in wetland or riparian habitats is prohibited.

II. PROVISIONS

A. Standard Provisions for NPDES Permits

The Discharger must comply with the "Standard Provisions for NPDES Permits," (Attachment B), which is made a part of this Order.

B. Monitoring and Reporting

1. Pursuant to California Water Code Section 13383, the Discharger shall comply with Attachment C - Monitoring and Reporting Program No. R6T-2010-0015, which is made a part of this Order, and with any revisions thereto.

2. The Executive Officer may require additional monitoring pursuant to California Water Code Section 13267, as necessary, to establish the recovery of aquatic macroinvertebrate communities following treatment, or to ensure compliance with other requirements and conditions of this NPDES Permit.

C. General Provisions for Monitoring and Reporting

The Discharger must comply with the "General Provisions for Monitoring and Reporting," (MRP Attachment 5), which is made a part of this Order.

D. Expiration

This Order expires five years from the date of its adoption, on April 13, 2015.

III. EXCEPTION FROM PRIORITY POLLUTANT CRITERIA/OBJECTIVES GRANTED

A categorical exception from meeting priority pollutant criteria/objectives is hereby granted subject to the provisions of State Implementation Policy section 5.3. The Discharger shall comply with all provisions of section 5.3 that are applicable to categorical exceptions.

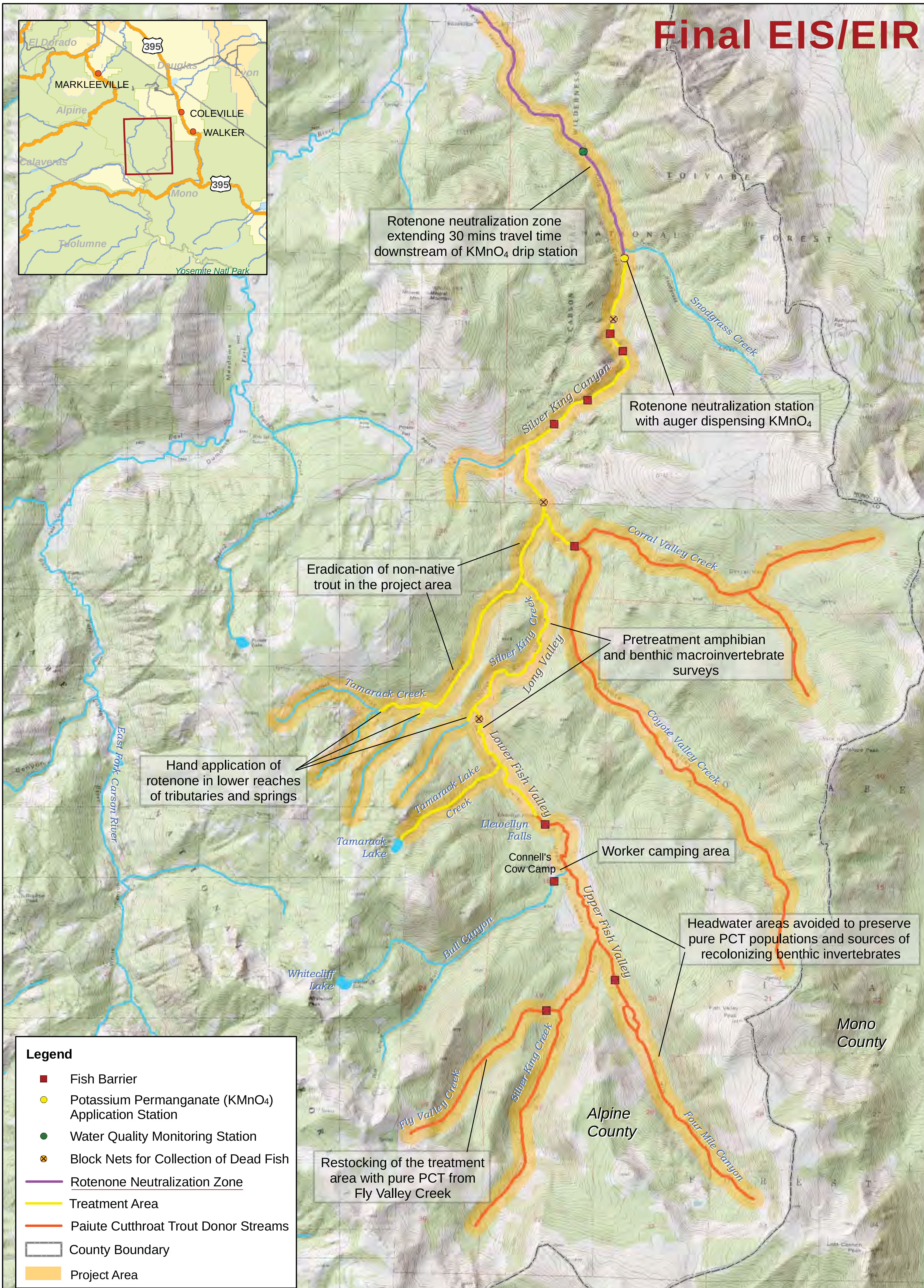
I, Harold J. Singer, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Lahontan Region, on April 14, 2010.

Harold J. Singer

HAROLD J. SINGER
EXECUTIVE OFFICER

Attachments: A. Project Location Map
B. Standard Provisions for NPDES Permits
C. Monitoring and Reporting Program

Attachment A



ENTRIX
ENVIRONMENTAL CONSULTANTS

0 0.5 1 2 Miles

Project area showing trout habitat in Silver King Creek, Humboldt-Toiyabe National Forest, Alpine County, California.

Final EIS/EIR

Paiute Cutthroat Trout Restoration Project

Figure 3-1

Proposed Action Components and Description

ATTACHMENT B

STANDARD PROVISIONS
FOR
NATIONAL POLLUTANT DISCHARGE
ELIMINATION SYSTEM (NPDES) PERMITS

1. The permittee must comply with all of the terms, requirements, and conditions of this NPDES Permit. Any violation of this Permit constitutes violation of the Clean Water Act (CWA), its regulations and the California Water Code, and is grounds for enforcement action, permit termination, permit revocation, and reissuance, denial of an application for permit reissuance; or a combination thereof.

2. The permittee shall comply with effluent standards or prohibitions established under 307(a) of the CWA for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if this Permit has not yet been modified to incorporate the requirement. [40 CFR 122.41(a)(l)]

   The California Water Code provides that any person who violates a Waste Discharge Requirement (same as permit condition), or a provision of the California Water Code, is subject to civil penalties of up to $1,000 per day or $10,000 per day of violation, or when the violation involves the discharge of pollutants, is subject to civil penalties of up to $10 per gallon per day or $20 per gallon per day of violation; or some combination thereof, depending on the violation, or upon the combination of violations.*

   Violations of any of the provisions of the NPDES program, or of any of the provisions of this Permit, may subject the violator to any of the penalties described herein, or any combination thereof, at the discretion of the prosecuting authority; except that only one kind of penalty may be applied for each kind of violation.*

3. The CWA provides that any person who violates a Permit condition implementing Sections 301, 302, 306, 307, or 308 of the CWA is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates Permit conditions implementing these Sections of the CWA is subject to a fine of not less than $2,500, nor more than $25,000 per day of violation, or by imprisonment for not more than one year, or both. [40 CFR 122.41(a)(2)]

4. If the permittee wishes to continue an activity regulated by this Permit after the expiration date of this Permit, the permittee must apply for and obtain a new Permit. [40 CFR 122.41(b)]

5. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Permit. [40 CFR 122.41(c)]

6. The permittee shall take all reasonable steps to minimize or prevent any discharge that has a reasonable likelihood of adversely affecting health or the environment. [40 CFR 122.41(d)]

7. The permittee shall, at all times, properly operate and maintain all the facilities and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with this Permit.

   Proper operation and maintenance includes adequate laboratory controls, and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities, or similar systems that are installed by a permittee only when necessary to achieve compliance with the conditions of this Permit. [40 CFR 122.41(e)]

8. This Permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a Permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition. [40 CFR 122.41(g)]

9. This Permit does not convey any property rights of any sort, or any exclusive privilege. [40 CFR 122 .41(f)]

10. The permittee shall furnish, within a reasonable time, any information the Regional Board or EPA may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Permit. The permittee shall also furnish to the Regional Board, upon request, copies of records required to be kept by this Permit. [40 CFR 122.41(h)]

11. The Regional Board, EPA, and other authorized representatives shall be allowed:

    (a) Entry upon premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this Permit;

    (b) Access to copy any records that are kept under the conditions of this Permit;

    (c) To inspect any facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Permit; and

    (d) To photograph, sample, and monitor for the purpose of assuring compliance with this Permit, or as otherwise authorized by the CWA. [40 CFR 122.41(I)]

12. Monitoring and records.

    (a) Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

    (b) The permittee shall retain records of all monitoring information, including all calibration and maintenance monitoring instrumentation, copies of all reports required by this Permit, and records of all data used to complete the application for this Permit, for a period of at least three years from the date of the sample, measurement, report, or application. This period may be extended by request of the Regional Board or EPA at any time.

    (c) Records of monitoring information shall include:

        (i) The date, exact place, and time of sampling or measurements;
        (ii) The individual(s) who performed the sampling or measurements;
        (iii) The date(s) analyses were performed;
        (iv) The individual(s) who performed the analyses;
        (v) The analytical techniques or methods used; and
        (vi) The results of such analyses.

    (d) Monitoring must be conducted according to test procedures under 40 CFR Part 136, unless other test procedures have been specified in this Permit.

(e) The CWA provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device, or method required to be maintained under this Permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

[40 CFR 122.41(j)]

13. All applications, reports, or information submitted to the Regional Board shall be signed and certified in accordance with 40 CFR 122.22 [40 CFR 122.41(k)(1)]

14. The CWA provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this Permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both. [40 CFR 122.41(k)(2)]

15. Reporting requirements:

(a) The permittee shall give advance notice to the Regional Board, as soon as possible of, any planned physical alterations, or additions to the permitted facility.

(b) The permittee shall give advance notice to the Regional Board of any planned changes in the permitted facility or activity that may result in noncompliance with permit requirements.

(c) This Permit is not transferable to any person, except after notice to the Regional Board. The Regional Board may require modification, or revocation and reissuance of the Permit to change the name of the permittee, and incorporate such other requirements as may be necessary under the CWA.

(d) Monitoring results shall be reported at the intervals specified elsewhere in this Permit.

(i) Monitoring results must be reported in a Discharge Monitoring Report (DMR).
(ii) If the permittee monitors any pollutant more frequently than required by this Permit using test procedures approved under 40 CFR Part 136 or as specified in this Permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR.
(iii) Calculations for all limitations that require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in this Permit.

(e) Report of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any compliance schedule of this Permit shall be submitted no later than 14 days following each schedule date.

(f) Twenty-four hour reporting.

(i) The permittee shall report any noncompliance that may endanger health or the environment to the Regional Board. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within five days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and time and, if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

(ii) The following shall be included as information that must be report within 24 hours under this paragraph;

(A) Any unanticipated bypass that exceeds any effluent limitation in the Permit.
(B) Any upset that exceeds any effluent limitation in the Permit.
(C) Violation of a maximum daily discharge limitation for any of the pollutants listed in this Permit to be reported within 24 hours.

(iii) The Regional Board may waive the above-required written report on a case-by-case basis.

(g) The permittee shall report all instances of noncompliance, not otherwise reported under the above paragraphs, at the time monitoring reports are submitted. The reports shall contain all information listed in paragraph 15(f) above.[40 CFR 122.41(1)]

16. Bypass (the intentional diversion of waste streams from any portion of facility) is prohibited. The Board may take enforcement action against the permittee for bypass unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage. (Severe property damage means substantial physical damage to property, damage to the treatment facilities that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.);

(b) There were no feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated waste, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that could occur during normal periods of equipment downtime or preventive maintenance; and

(c) The permittee submitted a notice, at least ten days in advance, of the need for a bypass to the appropriate Board.

The permittee may allow a bypass to occur that does not cause effluent limitations to be exceeded, but only if it is for essential maintenance to assure efficient operation. In such a case, the above bypass conditions are not applicable.

The permittee shall submit notice of an unanticipated bypass as required in paragraph 15(f) above. [40 CFR 122.41(m)]

17. Upset means an exceptional incident in which there is unintentional and temporary noncompliance with permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or

careless or improper action. A permittee that wishes to establish the affirmative defense of an upset in an action brought for noncompliance shall demonstrate, through signed, contemporaneous operating logs, or other relevant evidence that:

(a) an upset occurred and that the permittee can identify the cause(s) of the upset;

(b) the permitted facility was being properly operated at the tine of the upset;

(c) the permittee submitted notice of the upset as required in paragraph 15(f) above; and

(d) the permittee complied with any remedial measures required under paragraph 7.

No determination made before an action for noncompliance, such as during administrative review of claims that noncompliance was caused by an upset; is final administrative action subject to judicial review.

In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof. [40 CFR 122.41(n)]

18. All existing manufacturing, commercial, mining, and silvicultural dischargers must notify the Regional Board as soon as they know or have reason to believe:

(a) that any activity has occurred or will occur that would result in the discharge of any toxic pollutant that is not limited in this Permit, if that discharge will exceed the highest of the following "notification levels:"

(i) One hundred micrograms per liter (100 μg/L);
(ii) Two hundred micrograms per liter (200 μg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 μg/L) for 2-4dinitrophenol and 2-methyl-4-b-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
(iii) Five (5) times the maximum concentration value reported for that pollutant in the Permit application; or
(iv) The level established by the Regional Board in accordance with 40 CFR 122.44(f).

(b) that they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant that was not reported in the Permit application. [40 CFR 122.42(a)]

* This paragraph was added or modified by the State Water Quality Control Board to the California Water Code.

APPENDIX C

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

MONITORING AND REPORTING PROGRAM NO. R6T-2010-0015
WDID NO. 6A020405008
NPDES NO. CA0103209

FOR

CALIFORNIA DEPARTMENT OF FISH AND GAME
PAIUTE CUTTHROAT TROUT RESTORATION PROJECT

ALPINE COUNTY

I. MONITORING PROGRAM GOALS

A. To ensure compliance with receiving water limits established in Water Board Order R6T-2010-0015
B. To establish the nature and duration of rotenone treatment impacts to benthic macroinvertebrate populations, and verify that those populations and beneficial uses have been restored following treatment.
C. To detect, capture, and relocate out of the project area any threatened, endangered, sensitive, candidate or rare amphibians prior to rotenone treatment.

II. DETERMINATION OF PROJECT BOUNDARIES

The project boundaries for rotenone projects are defined, pursuant to the Basin Plan, as encompassing the treatment area, the detoxification area, and the area downstream of the detoxification station up to a thirty-minute in-stream travel time.

The California Department of Fish and Game (DFG, the Discharger) shall estimate the distance from the detoxification station to the downstream thirty-minute travel time endpoint, based on measurements of stream flow and/or average velocities, prior to commencement of rotenone application. This endpoint will define the downstream extremity of the project boundaries. The location of the project boundaries shall be identified one- to two-weeks before project implementation and recorded, along with any calculations used in making the determination.

III. SURFACE WATER MONITORING

A. Temperature

The Discharger shall measure and record water temperature whenever samples are collected for chemical analysis (according to the schedule described below), at the corresponding monitoring station and at the same time as sample collection.

B. Color

The Discharger shall visually inspect the stream water downstream of project boundaries at least three times a day during daylight operations, to ascertain whether discoloration due to potassium permanganate is discernible more than two miles downstream of project boundaries, and shall keep records of the observations.

C. Sample Location

Samples will be collected at the following locations, depicted in Attachment 1:

Station Code	Location Description
MSKC1	Silver King Creek, at project boundaries
MSKC2	Silver King Creek, immediately upstream of detoxification station
MSKC3	Silver King Creek, Lower Fish Valley
MSKC5	Silver King Creek, Long Valley
MSKC7	Silver King Creek Canyon
MTC1	Tamarack Creek, trail crossing
MTC2	Tamarack Creek
MTLC	Tamarack Lake Creek

All locations will be flagged and GPS locations will be determined and provided to the Water Board at least 24-hours prior to project implementation. Sample sites may need to be added or subtracted depending upon stream flow conditions and logistics on a given year. Changes in sampling protocol will be mutually agreed upon between the Discharger and the Water Board in advance of sample collection.

D. Sampling Methods, Analyses and Analytical Methods

Sampling protocols shall conform to the July 2, 2004 Monitoring Plan submitted by the Discharger, and incorporated herein by reference. Samples collected by the Discharger will be analyzed at the Department of Fish and Game laboratory certified by the California Department of Health Services. Water Board staff may independently sample and have samples analyzed at a separate laboratory for quality control. Constituents shall be sampled and results reported according to the following table:

Constituent	Analytical Methods	Units	Sample Type
Rotenone	McMillin and Finlayson, 2008[1]	µg/L	Grab
Rotenolone	McMillin and Finlayson, 2008[1]	µg/L	Grab
Volatile Organic Compounds (VOCs)	USEPA 8260	µg/L	Grab
Semi-Volatile Organic Compounds (SVOCs)	USEPA 8270	µg/L	Grab
Di(ethylene glycol) ethyl ether (DEE)	McMillin and Finlayson, 2008[1]	µg/L	Grab
1-methyl1-2-pyrrolidone (MP)	McMillin and Finlayson, 2008[1]	µg/L	Grab

[1] *McMillin, S. and B.J. Finlayson. 2008. Chemical residues in water and sediment following rotenone application to Lake Davis, California 2007, Appendix A: Water Pollution Control Laboratory Analytical Methods. California Department of Fish and Game, Pesticide Investigations Unit, OSPR Administrative Report 08-01, Rancho Cordova, California.*

E. Sampling Schedule

Samples shall be collected for analysis according to the schedule indicated in the following table. Pre-treatment samples shall be collected not more than 24 hours prior to application of rotenone. Sample timing may need to be changed depending upon stream flow conditions and logistics on a given year. Changes in sampling protocol will be mutually agreed upon between the Discharger and the Water Board in advance of sample collection.

Analysis	Site	Pre-Treatment	During Treatment	Day After Treatment	Weekly Post-Treatment
Rotenone & Rotenolone	MSKC1	X	every 2 hrs	X	X[2]
”	MSKC2	X	every 2 hrs	X	X[2]
“	MSKC3		Twice	X	X[2]
“	MSKC5		Twice	X	X[2]
“	MSKC7		Twice	X	X[2]
“	MTLC1		Twice	X	X[2]
“	MTC1		Twice	X	X[2]
“	MTC2		Twice	X	X[2]
VOC/SVOC	MSKC1	X	Twice		X[2]
“	MSKC2	X	Twice		
DEE/MP	MSCK1	X	Twice	X	X[2]
“	MTC1	X	Twice		
“	MTC2	X	Twice		

[2] If any chemical treatment residues are detected on the day after treatment at any sampling station, weekly samples shall be collected and analyzed at that station and any downstream station(s), until no residues are detected. Samples collected and analyzed pre-treatment and during treatment are done for operational purposes.

The Discharger shall take up to three additional samples within the treatment area the day after treatment as directed by Water Board staff, in collaboration with Department of Fish and Game personnel, where water is ponded, stagnant or slow moving. These locations will be identified using GPS equipment and shall be documented in monitoring reports that are available to the public.

F. Toxicity

Caged fish shall be used to determine whether detoxification is effective and ascertain whether rotenone toxicity has escaped beyond project boundaries. Prior to the discharge of rotenone formulation, caged fish shall be positioned just above the neutralization station, midway at the 15-minute stream travel time location, and at the project boundary 30 minutes travel time downstream of the detoxification station. The caged fish shall be maintained and observed for stress at least twice per day during treatment and detoxification operations, and observations shall be recorded. Stressed or dead caged fish will be replaced in accordance with the Discharger’s Neutralization Implementation Plan. Use of caged fish shall cease two days after cessation of rotenone application.

G. Benthic Macroinvertebrate Monitoring

The Discharger shall conduct aquatic macroinvertebrate monitoring according to the Silver King Creek Macroinvertebrate Monitoring, August 2007-2015 study plan submitted by the Discharger, and incorporated herein as Attachment 2, which is made a part of this Monitoring and Reporting Program.

H. Amphibian Surveys

The Discharger shall conduct amphibian surveys immediately prior to treatment, according to protocols described in Attachment 4.

I. Identification and Protection of Sensitive Macroinvertebrate Refugia Habitats

The Discharger shall use aerial photography, previous fishery and amphibian surveys, and field surveys to identify potential areas for sensitive macroinvertebrates. These waters shall be sampled or verified for the presence of non-native fish. Project team leaders shall reach consensus that the habitat or reach is fishless and will chemically treat only those sites that could not been verified as fishless, so as to not put the success of restoration project at risk for failure. After a decision is made, the water or habitat will be flagged and GPS waypoints logged for incorporation on project area maps as “no treatment areas.”

Annual inspections of no-treatment sensitive benthic macroinvertebrate refugia habitats will be performed to verify the absence of fish. Should annual inspections prior to subsequent treatments indicate that fish have colonized one or more of the habitats the no-treatment status of that specific habitat would be removed.

Project implementation teams will be provided treatment area maps with the non-treatment areas clearly identified and GPS waypoints would be loaded on each team member’s portable GPS unit. Prior to treatment individual team leaders would be oriented to each non-treatment habitat to ensure that every applicator has knowledge of the non-treatment status.

The Discharger shall conduct these surveys of springs, seeps, and headwaters in the project area no more than two weeks prior to treatment to determine whether or not they are fishless (where insufficient habitat or water volume exists at time of treatment to contain a fish). The Discharger shall communicate these locations to applicators and to Water Board staff through flagging, mapping, and GPS coordinates, as described above. The Discharger shall submit this information to the Water Board at least one day prior to treatment. **By November 1** of each year of any chemical treatment, the Discharger shall submit a final map certifying areas within project boundaries that received no rotenone application.

II. REPORTING

A. One day before treatment, the Discharger shall submit a draft map of treatment and “no treatment” areas. By November 1 of each year of any chemical treatment, the Discharger shall submit a final map certifying areas within project boundaries that received no rotenone application.

B. No later than 60 days of completion of each season’s treatment, the Discharger shall submit a monitoring report to the Water Board within The report shall include the following:

1. Data required by this monitoring and reporting program;
2. Approximate volumetric flow rate of each creek discharged to on application day;
3. Volume of rotenone product used, by location applied;
4. Amount of potassium permanganate used;
5. Summary of project; and
6. Evaluation of project success (eradication of non-native fish species after the third year of the project).

In reporting the monitoring data, the Discharger shall arrange the data in tabular form so that the date, the constituents, and the concentrations are readily discernible. The data shall be summarized in such a manner to clearly illustrate compliance with this Order.

B. The monitoring report shall include a cover letter containing the information and certification in the Monitoring and Reporting Cover Letter form (Attachment 3), which is hereby made a part of this Monitoring and Reporting Program.

C. The Discharger shall clearly identify in the monitoring report any violations of Board Order R6T-2010-(PROP), and submit a statement of corrective actions taken or proposed, including a timetable for implementation.

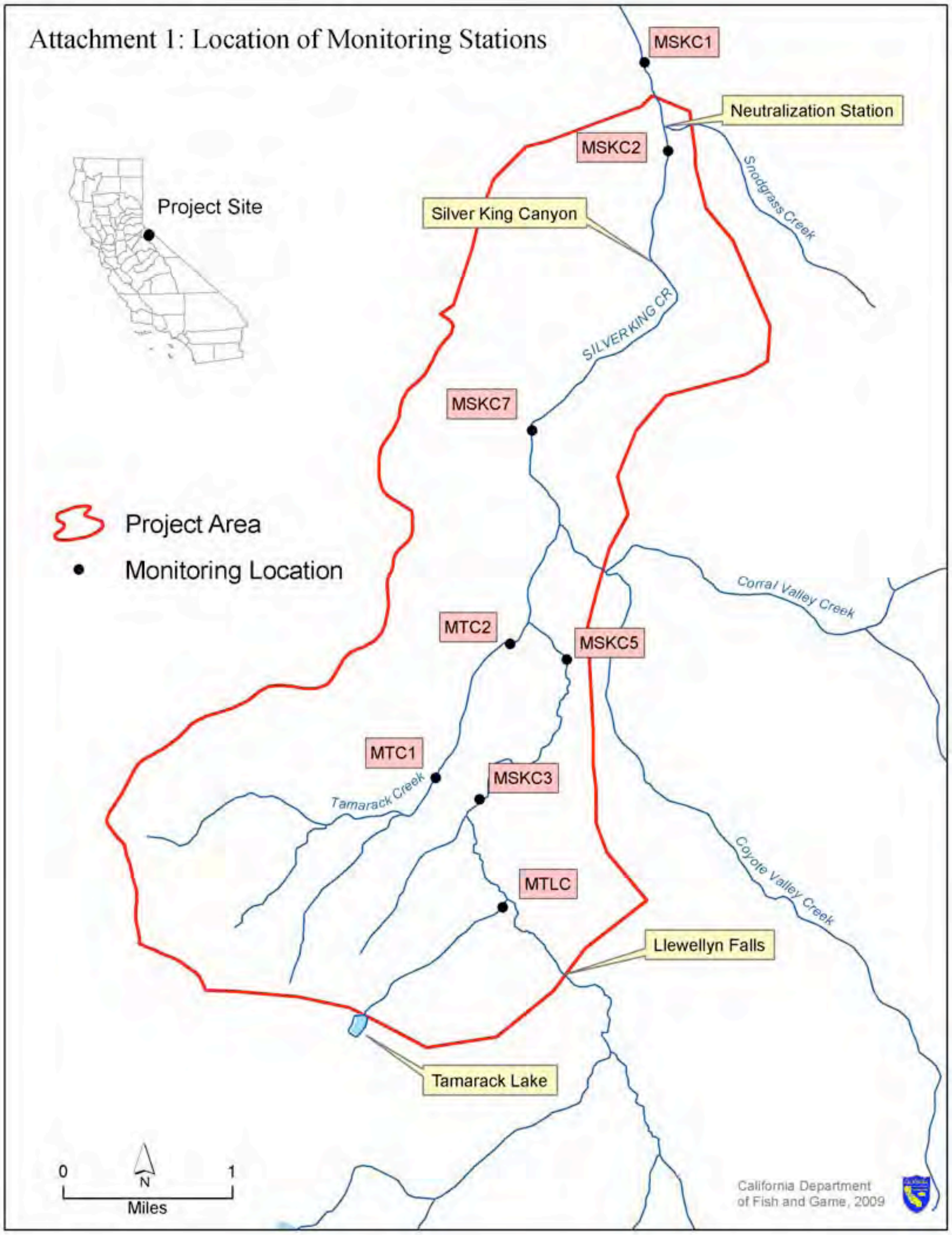
D. The Discharger shall submit a report to comply with condition 3 of Basin Plan Section 4.9, which states: “Within two years of the last treatment for a specific project, a fisheries biologist or related specialist from the DFG must assess the restoration of applicable beneficial uses to the treated waters, and certify in writing that those beneficial uses have been restored. A project will be considered to have been completed upon written acceptance by the Regional Board's Executive Officer of such certification."

III. The Discharger shall implement the above monitoring program immediately upon the commencement of the initial discharge covered by the Order. This Monitoring and Reporting Program may be modified by the Executive Officer.

Ordered by: Harold J. Singer
HAROLD J. SINGER
EXECUTIVE OFFICER

Dated: April 14, 2010

Attachments:
1. Map - Location of Monitoring Stations
2. Silver King Creek Macroinvertebrate Monitoring, August 2007-2015
3. Monitoring Report Cover Letter form
4. 2007 Sierra Nevada Fish and Amphibian Inventory Data Sheet Instructions



Attachment 1: Location of Monitoring Stations
MSKC1
Neutralization Station
MSKC2
Snodgrass Creek
Project Site
Silver King Canyon
SILVER KING CR
MSKC7
Project Area
Monitoring Location
Corral Valley Creek
MTC2
MSKC5
MTC1
MSKC3
Tamarack Creek
Coyote Valley Creek
MTLC
Llewellyn Falls
Tamarack Lake
0
N
1
Miles
California Department
of Fish and Game, 2009

Silver King Creek Macroinvertebrate Monitoring August 2007-2015

Background

The California Department of Fish and Game and the U.S. Fish and Wildlife Service propose to treat Silver King Creek basin with rotenone during the late summer of 2009, 2010, and possibly 2011. The goal of this project is to restore Paiute cutthroat trout (*Oncorhynchus clarkii seleniris*), a federally listed threatened species, to its historic habitat**.**

While rotenone is intended to eradicate non-native trout, it is also toxic to some aquatic macroinvertebrates. Rotenone was first used in the Silver King Creek basin in 1964, and on various occasions and locations up to 1993. Macroinvertebrate sampling within the basin began in 1984 and has occurred periodically up to 2007.

This monitoring study differs from the June 15, 2003, Interagency Study Proposal in that it incorporates more sampling stations throughout the basin as well as additional "control" and "treatment" sites. The sampling methodology is also changed to allow for additional analyses such as the River Invertebrate Prediction and Classification System (RIVPACS) analysis model (Hawkins et al. 2000).

Objectives

The primary objectives of this study are to: 1) analyze changes in macroinvertebrate assemblages and taxa from the use of rotenone during Paiute cutthroat trout recovery activities, 2) collect and identify taxa from the Silver King Creek basin, and 3) reestablish historic collection sites in selected streams.

Study Design

Twenty-three quantitative and 5 qualitative sampling site locations were established during August 2007 (Table 1). This study design differs from the June 15, 2003, Interagency Study Proposal in that it incorporates more sampling stations throughout the basin as well as additional "control" and "treatment" sites (nine pairs) (Figures 1 and 2). Five qualitative sampling sites were established within the area to be treated to increase the likelihood of collecting taxa with low relative abundances, i.e. rare taxa (Figure 3). The sampling methodology is also changed to allow for additional analyses.

Past analyses to evaluate the effects of rotenone on aquatic biota are hampered by the lack of data on aquatic invertebrate assemblages prior to the use of rotenone (Vinson and Vinson 2007). This monitoring effort includes five quantitative sampling sites (SKC Site 1 & 2, Tamarack Sites 1-3) and 3 qualitative sampling sites (SKC Site 1, Tamarack Sites

1 & 2) in areas that have never been treated with rotenone which are expected to be treated in the future.

Pre-treatment sampling will be conducted at all sites during mid-August 2007, and 2008. Further pre-treatment sampling will also be conducted at all sites during mid-August 2009, immediately prior to treatment. Post-treatment monitoring will be conducted during mid-August the first year after treatment, 3 years post-treatment, and 5 years post-treatment.

Table 1. Sample type and locations within the Silver King Creek basin.

Stream	**Site Number**	**Sample Type**	**Site Type**	**UTM North**	**UTM East**	**Elev. (m)**
Bull Creek	Bull Site 1	Quantitative		4259066	273218	2457
Corral Creek	Corral Site 1	Quantitative		4263805	274123	2424
Corral Creek	Corral Site 2	Quantitative		4263251	275248	2510
Coyote Creek	Coyote Site 1	Quantitative	Control	4262687	273342	2411
Coyote Creek	Coyote Site 2	Quantitative	Control	4261839	273608	2481
Coyote Creek	Coyote Site 3	Quantitative	Control	4260799	274522	2492
Fly Valley Creek	Fly Site 1	Quantitative		4256568	272140	2653
Four Mile Creek	Four Mile Site 1	Quantitative		4257098	274165	2560
Silver King Creek	SKC Site 1	Quantitative	Treatment	4264901	272645	2333
Silver King Creek	SKC Site 2	Quantitative	Treatment	4263842	272756	2345
Silver King Creek	SKC Site 3	Quantitative	Treatment	4262456	272874	2376
Silver King Creek	SKC Site 4	Quantitative	Treatment	4262005	272675	2383
Silver King Creek	SKC Site 5	Quantitative	Treatment	4260832	272085	2416
Silver King Creek	SKC Site 6	Quantitative	Treatment	4260099	272602	2426
Silver King Creek	SKC Site 7	Quantitative	Control	4259608	273247	2456
Silver King Creek	SKC Site 8	Quantitative	Control	4259289	273140	2460
Silver King Creek	SKC Site 9	Quantitative	Control	4258963	273359	2462
Silver King Creek	SKC Site 10	Quantitative	Control	4258354	273562	2473
Silver King Creek	SKC Site 11	Quantitative	Control	4257651	273471	2503
Silver King Creek	SKC Site 12	Quantitative	Control	4257022	273187	2506
Tamarack Creek	Tamarack Site 2	Quantitative	Treatment	4261479	271383	2422
Tamarack Creek	Tamarack Site 1	Quantitative	Treatment	4262448	271943	2400
Tamarack Creek	Tamarack Site 3	Quantitative	Treatment	4261437	270915	2443
Silver King Creek	SKC Site 1	Qualitative		4264901	272645	2333
Silver King Creek	SKC Site 2	Qualitative		4260655	272242	2416
Silver King Creek	SKC Site 3	Qualitative		4259883	272755	2425
Tamarack Creek	Tamarack Site 1	Qualitative		4261873	271653	2411
Tamarack Creek	Tamarack Site 2	Qualitative		4261457	270972	2439

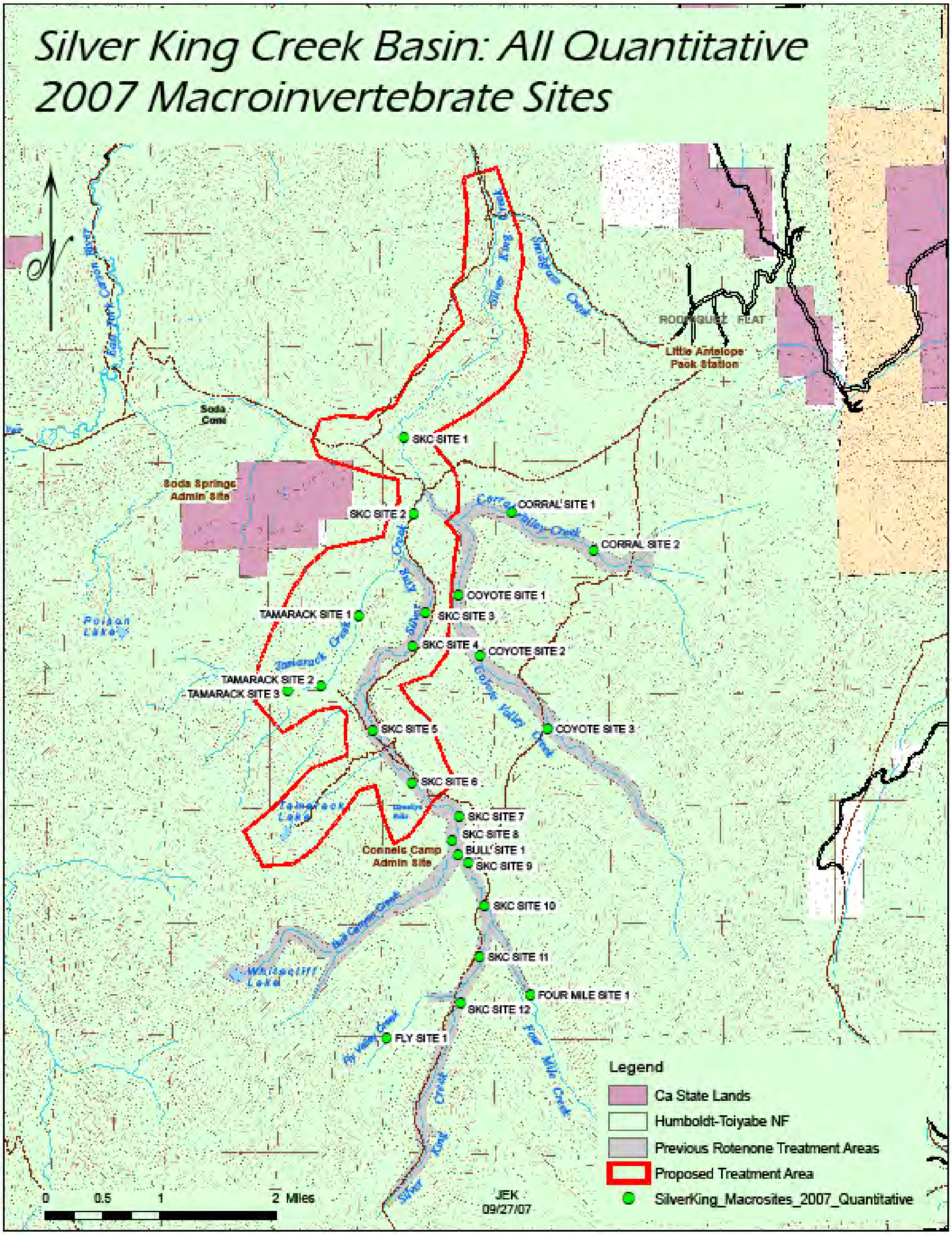


Figure 1. Quantitative sampling sites within the Silver King Creek basin.

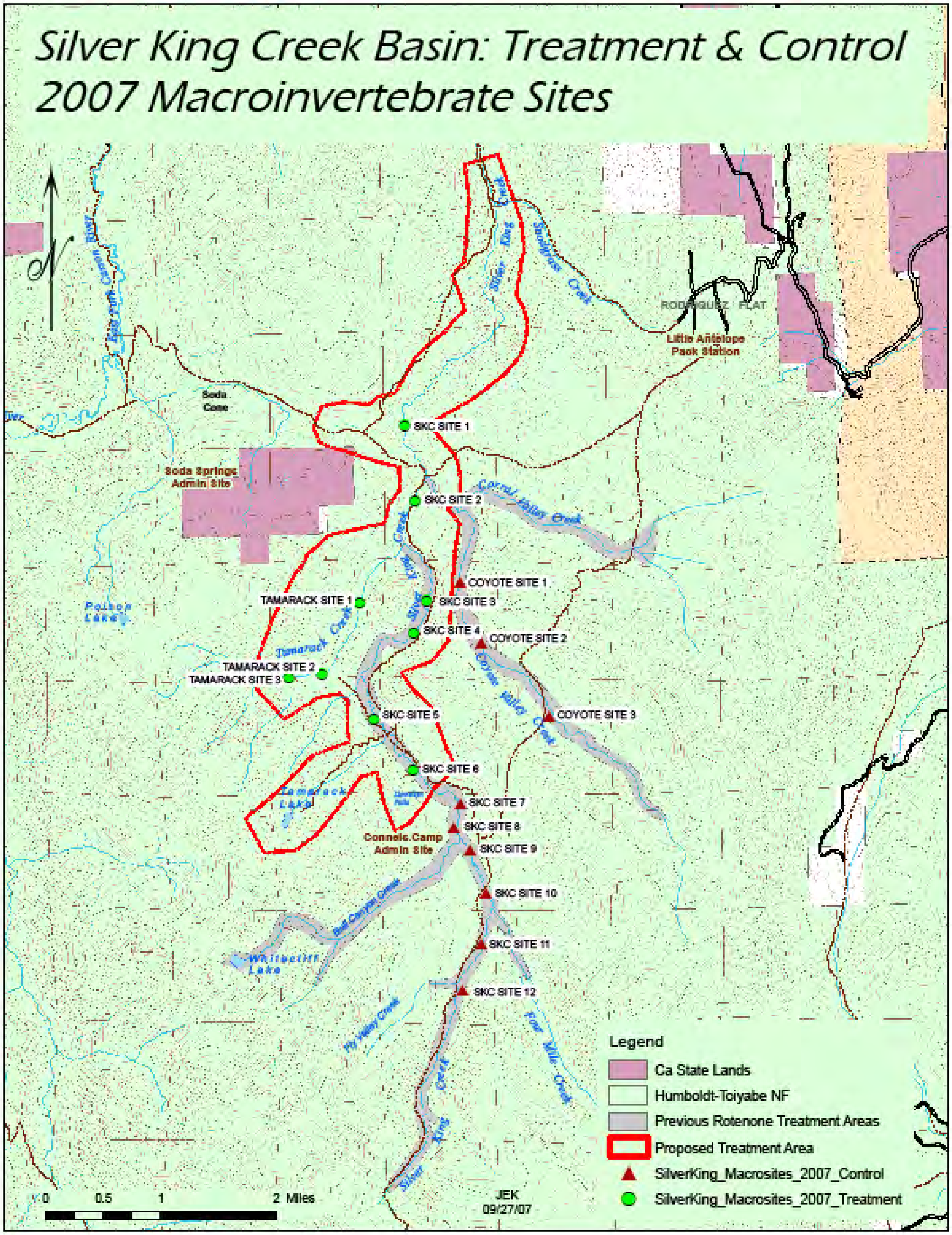


Figure 2. Quantitative sampling "control" and "treatment" sites within the Silver King Creek basin.

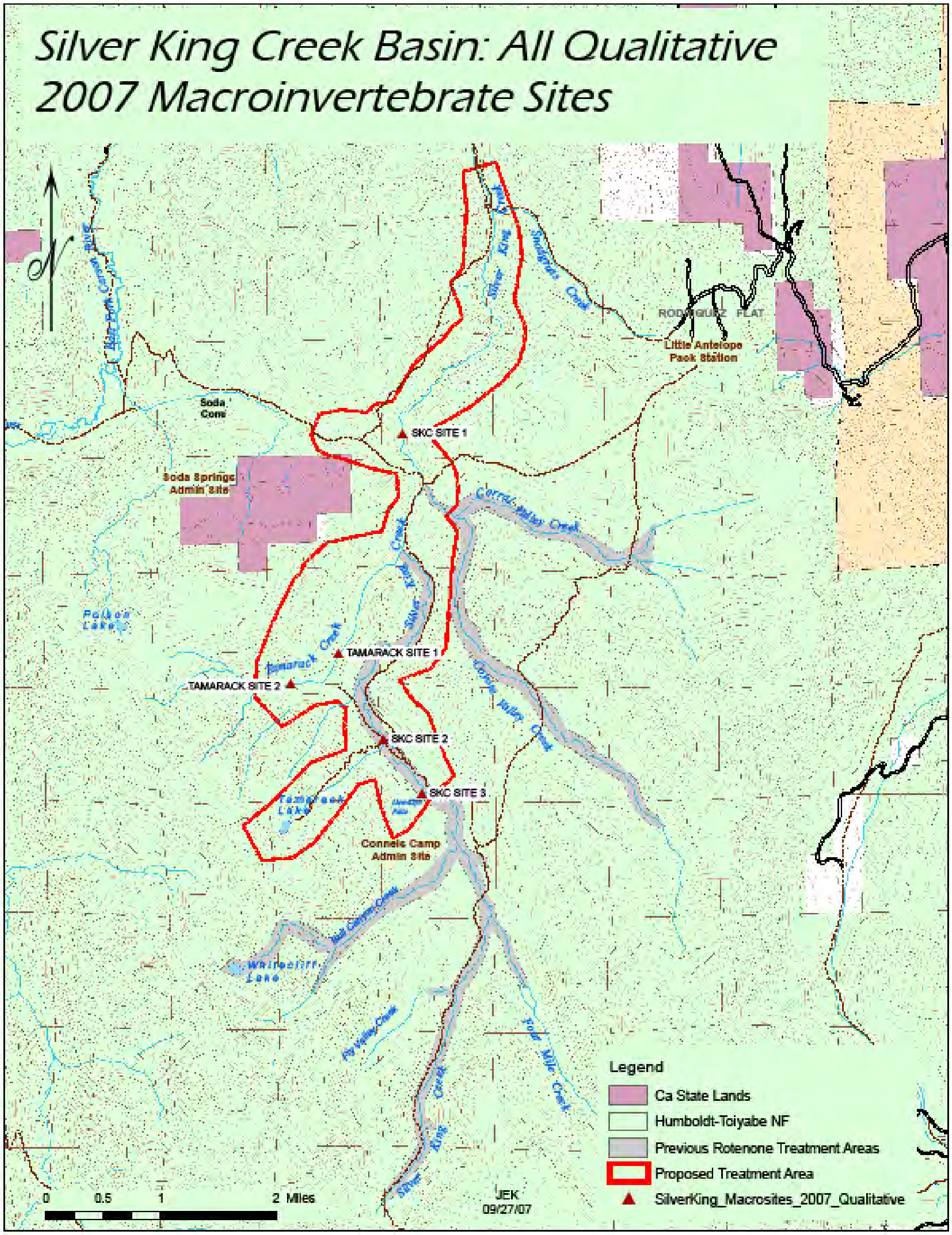


Figure 3. Qualitative sampling sites within the Silver King Creek basin.

Sampling Methods

Stream Invertebrate Collection Procedures as described by the National Aquatic Monitoring Center at Utah State University, Logan, Utah (www.usu.edu/buglab/) will be followed. Samples will be sent to the National Aquatic Monitoring Center at Utah State University, Logan, Utah for processing (see www.usu.edu/buglab/ for laboratory methods). Table 2 provides the normal taxonomic resolution of processed samples.

Fixed Area Quantitative Samples

The objective of quantitative invertebrate sampling is to collect the more common invertebrates at a site and estimate their relative abundances. Quantitative samples are collected using a Surber net (0.09 m^2) with a 500 micron mesh net. Eight samples are collected in 4 different riffles (2 samples from each riffle) and composited to make a single sample of approximately 0.74 m^2 for each location on each sampling date.

Qualitative Invertebrate Collections

The objective of qualitative invertebrate collections is to collect as many different kinds of invertebrates living at a site as possible. Samples are collected with a Surber net or a kicknet (457 x 229 mm) with a 500 micron mesh net and by hand picking invertebrates from woody debris and large boulders. All major habitat types (e.g., riffles, pools, back waters, macrophyte beds) are sampled and all samples are composited to form a single sample from each site.

Table 2. Normal taxonomic resolution provided by the National Aquatic Monitoring Center.

Taxon or Taxa group	**BugLab's Current Standard Taxonomic Level**	**Northwest Bioassessment Work Group Minimum Standard Taxonomic Effort**
Annelida		
Hirudinea	Genus/species	Genus
Oligochaeta	Order	Family
Arthropoda		
Hydracarina	Family/Genus/species	Order
Crustacea		
Anostraca	Genus/species	Genus/species
Cladocera	Genus/species	
Copepoda	Genus/species	
Decapoda	Genus/species	Genus
Ostracoda	Order/Family/Genus	

Table 2. Continued.

Taxon or Taxa group	**BugLab's Current Standard Taxonomic Level**	**Northwest Bioassessment Work Group Minimum Standard Taxonomic Effort**
Arthropoda		
Crustacea		
Amphipoda	Genus/species	Genus
Isopoda	Genus	Genus
Collembola	Order	
Insecta		
Coleoptera	Genus/species	Genus
Except Curculionidae, Heteroceridae, Ptiliidae	Family	Family
Diptera		
Atherceridae	Genus/species	Genus
Blephariceridae	Genus/species	Genus
Ceratopogonidae	Genus	Subfamily
Chaoboridae	Genus	
Chironomidae	Subfamily	Genus
Culicidae	Genus	
Deuterophlebiidae	Genus/species	Genus
Dixidae	Genus	Genus
Dolichopodidae	Family	Family
Empididae	Genus	Genus
Ephydridae	Family	Family
Muscidae	Family	Family
Pelecorhynchidae	Genus	Genus
Psychodidae	Genus	Genus
Ptychopteridae	Genus	Genus
Sciomyzidae	Family	
Simuliidae	Genus	Genus
Stratiomyidae	Genus	Genus
Tabanidae	Genus	Family
Tanyderidae	Genus	Genus
Thaumaleidae	Genus	Genus
Tipulidae	Genus	Genus
Ephemeroptera	Genus/species	Genus
Ephemerellidae	species	species
Hemiptera	Genus/species	Genus

Table 2. Continued.		
Taxon or Taxa group	**BugLab's Current Standard Taxonomic Level**	**Northwest Bioassessment Work Group Minimum Standard Taxonomic Effort**
Arthropoda		
Lepidoptera	Genus	Genus
Megaloptera	Genus/species	Genus
Odonata	Genus/species	Genus
Plecoptera	Genus/species	Genus
Pteronarcyidae	species	species
Taeniopterygidae	Family/Genus	Family
Trichoptera	Genus/species	
Coelenterata	Class	Class/Order
Mollusca		
Gastropoda	Family/Genus/species	Genus
Pelecypoda	Order/Family/Genus	Genus
Sphaeriidae	Genus/species	Family/Genus
Nematoda	Phylum	Phylum
Nematophora	Phylum	Phylum
Porifera	Phylum	Phylum
Turbellaria	Class	Class

Data summarization

As part of the National Aquatic Monitoring Center standard reporting, the following metrics or ecological summaries are provided for each sampling station:

Taxa richness, Genera richness
EPT
Percent taxon or family dominance
Biotic indices - Hilsenhoff Biotic Index
USFS Community tolerant quotient
Shredders
Collector-filterers
Predators
Clinger taxa

Abundance
Number of families
Shannon Diversity Index
Evenness
Functional feeding group measures
Scrapers
Collector-gatherers
Unknown feeding group
Long-live taxa

Additional information on the metrics and how they are calculated can be found at www.usu.edu/buglab/.

Statistical analyses

An equal number (nine pairs) of control and treatment sites will sampled before and after the treatment with rotenone. Pre-treatment sampling will occur in 2007, 2008, and 2009; post-treatment monitoring will be conducted during mid-August the first year after treatment, 3 years post-treatment, and 5 years post-treatment. This will allow for a BACI (Before-After-Control-Impact) analysis to be used to detect treatment effects to biological metrics. BACI analyses will follow 2 methodologies, designed to detect both short and long-term impacts. The first method is the standard BACI, where the time scale is constrained to the sampling period immediately before and after treatment. A 2-way ANOVA on selected metrics (e.g. abundance, tolerance values) with Time (Before/After) and Site (Control/Impact) is then performed, with rotenone effects assessed using the interaction term (Green 1979). Long-term effects will be analyzed using a BACIPS (Before-After-Control-Impact Paired Series) (Stewart-Oaten 1996). In this, an average metric value for each sampling period for Control sites and Treatment sites are determined, and the difference between the averages is the response variable analyzed statistically. The differences in pre-treatment versus post-treatments are then analyzed using a basic *t*-test. Metrics to be analyzed may also include aquatic invertebrate abundance and taxa richness (genera) which Vinson and Vinson 2007 suggest that differences would be detectable following a rotenone treatment. ANOVA may be also used to evaluate differences in aquatic invertebrate assemblage measures between pre-treatment and post-samples to detect treatment effects. Simple graphs of before and after comparisons will be used to evaluate differences in invertebrate assemblage measures and diversity indices between pre-treatment and post-treatment periods (Vinson and Dinger 2006).

RIVPAC analysis will also be conducted. This analysis allows for the prediction of what taxa should occur at a site in the absence of anthropogenic actions and factors in the probability of occurrences for all individual.

Accumulation curves will be used to provide information on the adequacy of sampling and on the relative number of taxa that may be present but are yet uncollected. These methods will be used following treatment to evaluate assemblage recovery. Rare taxa, (those whose individual abundances are less than 1% of the total sample abundance) will be identified in pre-treatment sampling and tracked post-treatment to detect treatment effects. Of particular interest will be sampling sites, Tamarack 1-3 and Silver King 1 & 2, which are areas that haven’t been treated with rotenone.

Historic Site monitoring

Long-term sampling sites have been reestablished on Fly Valley Creek, Four-mile Creek, Bull Canyon, and at upstream historic sites in Silver King Creek. Although this monitoring study uses a different sampling design from those used historically, sampling these sites could provide additional information on historic assemblages. The Fly Valley and Four-mile creeks sites are in areas that were never chemically treated and will not be treated.

References

Green, R.H. 1979. Sampling design and statistical analysis for environmental biologists. Wiley-Interscience. New York.

Hawkins, C.P., R.H. Norris, J.N. Hogue, and J.W. Feminella. 2000. Development and evaluation of predictive models for measuring the biological integrity of streams. Ecological Applications 10:1456-1477.

Stewart-Oaten, A. 1996. Problems in the analysis of environmental monitoring data. Pages 109 – 132 In Schmitt, R.J. and C.W. Osenberg, eds. *Detecting Ecological Impacts: Concepts and applications in coastal habitats*. Academic Press. New York.

Vinson, M.R., and E. Dinger 2006. Rotenone effects on the aquatic macroinvertebrates of the Virgin River in the vicinity of the Webb Hill Barrier near St. George, Utah, 2003-2005. Final Report for Project Number: IV.A.1. Washington County Water Conservancy District. St. George, Utah. 33 pp.

Vinson, M.R., and D. K. Vinson. 2007. An Analysis of the Effects of Rotenone on Aquatic Invertebrate assemblages in the Silver King Creek Basin, California. Final Report prepared for U.S. Forest Service, Humboldt-Toiyabe National Forest Carson City, NV. 255 pp.

Date ______________

Attachment 3
Monitoring Report Cover Letter

California Regional Water Quality Control Board
Lahontan Region
2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150

Facility Name: ____
____

Address: ____
____
____
____

Contact Person: ____

Job Title: ____

Phone: ____

Email: ____

WDR/NPDES Order Number: ____

WDID Number: ____

Type of Report (circle one): **Monthly Quarterly Semi-Annual Annual Other**

Month(s) (circle applicable month(s)*): **JAN FEB MAR APR MAY JUN**
JUL AUG SEP OCT NOV DEC

***annual Reports** (circle the first month of the reporting period)

Year: ____

Violation(s)? (Please check one): __________**NO** __________ **YES***

***If YES is marked complete a-g (Attach Additional information as necessary)**

a) Brief Description of Violation: ____
____
____
____
____

b) Section(s) of WDRs/NPDES Permit Violated: ____
____
____
____

c) Reported Value(s) or Volume: ______________________________

____

____

d) WDRs/NPDES Limit/Condition: ______________________________

____

____

e) Date(s) and Duration of Violation(s): ______________________________

____

____

f) Explanation of Cause(s): ______________________________

____

____

____

____

g) Corrective Action(s)
(Specify actions taken and a schedule for actions to be taken)

____

____

____

____

____

____

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision following a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my knowledge of the person(s) who manage the system, or those directly responsible for data gathering, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

If you have any questions or require additional information, please contact ____________________ at the number provided above.

Sincerely,

Signature: ______________________________

Name: ______________________________

Title: ______________________________

2007 Sierra Nevada Fish and Amphibian Inventory Data Sheet Instructions
Version 2.3 May-15-07

California Department of Fish & Game
Fish/Amphibian Survey Protocols

Overview

Fill out a separate data sheet (substitute “Palm entry” for “data sheet” as necessary) for **every** lake and pond that has a Site ID, regardless of how un-lake like the site is. If the site is dry, frozen, part of another sampled water body, or is a widening of a stream (i.e., there is a current flowing through the site), indicate why a full datasheet was not filled out on the map portion of the datasheet or the notampled field and comment field of survey main (e.g., "pond was dry"). Some data subforms will still need to be filled out in the Palm unit (see below). If you encounter ponds not shown on the 7.5' maps, fill out a data sheet if they contain fish, amphibians, and/or fairy shrimp. Meadows, marshes, and spring seeps should always be surveyed, even if they do not have Site IDs. When you visit non-lake habitat such as marshes that contain extensive ponded water, complete a single survey for the entire area. It is critical that all relevant portions of each data sheet be filled out, and that non-relevant portions be indicated as such, not simply left blank. Remember, if the data sheet is improperly filled out, the visit was a complete waste of time and money.

When you complete surveys in habitats that do not contain ponded water (e.g., streams), record the start and end UTM coordinates in the amphibian/reptile visual survey section and complete all other pertinent sections. Many stream sections that will be surveyed are associated with other Site IDs (e.g., 200 m of each inlet and outlet) and the survey data should be entered on the associated Site ID’s data sheet. Record all observations in ball point pen. Keep data notebooks and otoliths in separate Ziplock bags to prevent labels from being erased by leaking alcohol.

Recording Numbers: Use the dot-line method for recording the number of "hits" in fields that require a count (4 hits: ; 8 hits: ; 10 hits:), instead of the more typical four vertical lines and a slash. The dot-line method is much more space-efficient and is easier to read. In addition to categorizing the substrate type at each spot, record the presence or absence of aquatic vegetation at each spot (record hits using the dot-line method).

General Lake Description / Survey Main

Site ID: This is a *critical* number, as it will be used to link the data sheet to a particular body of water and to identify all samples. This ID is written on the 7.5' maps available for crews to take into the field. Check the Site ID carefully before recording it on the data sheet. If you encounter a lake or pond that is not shown on the 7.5' map or a marsh, meadow or spring seep that does not have a Site ID, its Site ID will be the number of the **nearest lake or pond that has a Site ID** plus a decimal place identifier (e.g., 70377.01). Additional Site ID's for nearby unnumbered lake features will be made using consecutive numbers (e.g., 70377.02, 70377.03).

Location: This description should **always** be provided, and must be detailed enough to allow someone not familiar with the area to pinpoint the lake on a topographic map. This information is particularly critical for unnamed lakes because the GPS point is the only other reference for the location of the water body. Do not leave this space blank, no matter how obvious the lake feature is. At a minimum, give the distance and the compass direction from the site to two nearby prominent named geographical features (e.g., lakes, peaks, etc.). Lake and peak names, distances, and compass directions should be taken from 7.5' maps. Palm - Use the survey main comment field to note location.

Date: Write as month-day-year (Aug-10-01) and always use the three letter abbreviation for month. Palm- ensure this field auto-populates correctly. If your palm’s date is incorrect this field will also be incorrect. If entering data in a palm after the survey was conducted, be sure to change the value of this field to the appropriate survey date BEFORE opening any subforms.

Lake name: Lake names generally originate from the 7.5’ topo map. However, CDFG has also implemented its own naming system for the stocking program. Field crews should have a pre-generated field lake checklist with the proper CDFG lake name and corresponding Site ID. Use this list to populate the Lake name field.

Palm - Lake names should be auto-populated based upon the names from the high_mountain_lakes.shp in the GIS data framework. These names are not always correct. If the correct name is known, or the name was not auto-populated, replace the auto-populated contents with the correct name as appropriate.

Note – consecutively numbered lakes (i.e. Big Pine Lake 1, Big Pine Lake 2, etc.) are numbered starting from lowest elevation and ending at the highest elevation lake.

Water type: Circle the appropriate descriptor for the water type you are surveying (lake, unmapped pond, stream, marsh/meadow, spring seep). Palm-depending on the watertype, certain subforms must be completed.

Lakes should always receive the full protocol and have all applicable fields filled out.

Any unmapped lotic water body that is surveyed, regardless of size, falls under the category of “unmapped pond”, circle water type = 3 (unmapped pond). Unmapped ponds should be completely surveyed as are lakes. Visual fish surveys are not acceptable if fish are present even if the site is small and unmapped.

Stream sites should have a complete VES, visual fish survey, shrimp survey, and photo, but do not require littoral and shoreline habitat surveys or inlet and outlet surveys. Palm - Remember to record the start and end GPS points of the stream reach surveyed in the amphibian header subform.

Marsh/Meadow sites should be surveyed as a single site. GPS the perimeter of the site and record the coordinates in the comment field (these will be used to generate a GIS polygon for the site). Record as many points as needed to characterize the general shape of the marsh/meadow. Usually less than 10 points will suffice. Complete a VES, visual fish survey, shrimp survey, photo, and inlet/outlet surveys (if applicable). Littoral and shoreline habitat surveys do not apply.

Spring seep sites should have a VES, visual fish survey, shrimp survey, and photo. Littoral and shoreline habitat surveys do not apply.

Seasonality: The determination of whether a water body is perennial or ephemeral should be made based on field determination. Cues such as grass or terrestrial vegetation on the lake bottom; undecomposed duff; obvious bath tub ring; or low lake level can be used to assess status. 7.5’ maps may help the surveyor make a call. Perennial lakes and ponds are shown in dark blue, ephemeral lakes and ponds are shown in white with blue diagonal lines, and marshes are indicated by a marsh symbol.

Not Sampled: If the water body indicated on the map is frozen, dry, not found, part of another water body, or is a stream widening, your sampling will be limited. Circle the appropriate reason why the water body was not fully sampled: stream widening, frozen, dry, not found, or part of another water body.

Frozen water bodies can usually be handled in one of two ways. Completely frozen sites offer little to no opportunity to survey for animals, thus indicate the site is frozen in the appropriate check box and comment fields and move on. Partially frozen sites may offer some opportunity to VES for amphibians, furthermore, this is often the time when high mountain species begin breeding. Indicate in the comments that the site is partially frozen, take an overview photo, and conduct a VES.

Dry sites can often have newly metamorphed bufo species and hyla regilla. VES the site, including any tributaries, and take an overview photo.

Sites that are not found should have only the top box of the data sheet filled out, indicating that the site was not found in the “Location” box. Palm – fill out a survey main and indicate in the comment field that the site was not found.

Stream widenings are those water bodies shown as perennial ponds but that have more than 10% of their surface area with noticeable current, i.e., these are more like stream pools than ponds.

If the water body of interest is actually part of another water body, sample and complete a data sheet for the larger water body, and fill out only the top box of the data sheet for the smaller water body, indicating that it is actually part of the larger water body in the “Location” box. In other words, the site that is considered part of another waterbody, will receive a full survey under the Lake ID of the larger site. Palm – fill out a survey main for the site but indicate in the comments that the full data set is associated with a different site and list the site ID.

Planning Watershed: The watershed name for all lakes is given on the "Lakes Checklist." Do not use the name of the outlet creek given on the 7.5' map as the drainage name, as this may not be a complete description.
Palm - The watershed name should be auto-populated for all pre-identified site IDs (i.e. those ending in .00). If a new site is being surveyed, use your survey map to identify which planning watershed the new site is located in, and pick the appropriate watershed name from the picklist.

County: Record the county (from 7.5' map) in which the lake feature lies.

Elevation: Record the elevation from the 7.5' map, or a calibrated altimeter (such as the altimeter feature in the Garmin eTrix Vista GPS). When using the map look for labeled contour lines to determine contour interval distance and units. Be aware that maps generated in the office by GIS software that span multiple 7.5' quads may display intervals in both meters and feet. The lake elevation is the average of the contour line below the lake and the contour line above the lake. Thus, if a lake is between the 9860' contour and the 9900' contour, the lake elevation should be recorded as 9880'. A common mistake is to assume that the proximity of a lake to a contour line indicates that the elevation of the lake is close to the value of that contour line. The horizontal distance between two points on a topographic map bears no relationship to the vertical distance between those same two points. Record the units used (m or ft).

If the lake has a water level elevation (i.e. WL 9832), use this number in the elevation field (note- water level elevations are a good source to calibrate an altimeter).

Avoid using the GPS estimated elevation because this number is highly inaccurate (+/- 200meters in many cases).

UTM Coordinates: This is a pair of numbers that are basically x and y coordinates. In our area, they are North and East. These numbers need only be obtained for lakes not shown on the 7.5' maps or for those lakes lacking a Site ID. Use a GPS unit to obtain the UTM coordinates. Also record the UTM zone that you are in. **Make sure your GPS is setup in UTM NAD83**. These coordinates are critical as they will be used to map the lake.

Topographic map: Record the name of the 7.5' topographic map (or "quad") that contains the lake feature. These are listed in the legend on our CDFG navigation maps. Palm- not used in Palm.

Maximum lake depth: Measure maximum lake depth with the Speedtech SM-5 Depthmate Portable Sounder. Do not spend inordinate amounts of time sounding every part of the lake to find exactly the deepest part. By sounding the deepest-looking piece of the lake, you will quickly get a feel for where the deepest spot actually is. Precise measurements of "maximum depth" are not very important in large deep lakes. However, in shallow lakes (< 5 m) a precise depth (± 0.5 m) is very important. Plan to take maximum depths when setting or retrieving gill nets, but the data must still be collected even when nets are not set. **This data field was ignored too often in the past but is one of the more important data for determining future management options!** Enter this value on the Fish Data Form at the top of page 3, or at the bottom on page 2 if no gill net fish survey was completed for a site. In the Palms the Max Depth field is located in the Fish Header Subform.

Maximum lake depth should be measured even when field crews are not equipped with a depth sounder. There are many methods to improvise and collect depth measurement, but the simplest is often a known length of cord and a rock.

Team Members: Use complete names. Palm - All crew involved in data collection should be recorded in the Surveyors Subform. The VES crew should be listed in the amphibian surveyours subform.

Lake Characteristics

The habitat characterization is perhaps the most subjective of the measurements made using this protocol., and we hope to reduce the potentially high observer bias by stressing the need for survey consistency. In other words, it is important to practice the protocol, calibrate visual estimates with real measurements, check each other's data, and maintain consistent survey methods.

Littoral zone substrate composition: While walking around the lake perimeter during the VES survey (see Amphibian/Reptile Surveying, below), stop after a set number of paces (see below) and categorize the **dominant** substrate at the lake edge as one of the following: silt, sand (<2mm), gravel (2-32mm), small cobble (32-64mm), large cobble (64-256mm), boulder (>256mm), bedrock, or woody debris (pine needles and pine cones = “woody debris”).

Categorize the substrate along an imaginary transect line starting at the lake edge, extending perpendicular from shore, and lying along the first **3 meters** (10 feet) of the lake bottom. Record the number of hits for each substrate category in the appropriate field. Record a “0” for categories with no hits. Only record aquatic vegetation hits on transect with at least 10% coverage. This avoids over-representing aquatic vegetation in the lake characterization. Record this information under "Substrate transects with aquatic vegetation". Increase the number of paces between transects when surveying large lakes and decrease the number of paces for small ponds. Shoot for fifty transects, as this is a sufficient number to provide an accurate description of the littoral zone of lakes. Lake perimeter (auto-populated in survey main for existing sites, or estimated) can be divided by 50 for number of meters between transects.

For very small sites where you can observe the entire littoral zone substrate from a single location, it is permissible to estimate the littoral substrate composition by size category visually, and then to record your estimates as percent values for each size category (make sure the total of all substrate categories equals 100%). If the lake contains large numbers of amphibians, conduct the amphibian/reptile survey first and then walk around the lake a second time to measure substrate composition.

Record the name of the person conducting the survey of lake characteristics ("Person recording habitat information").

Littoral zone depth: At each of the littoral zone transects, also record the water depth at **one meter** from the shoreline and record in one of the following depth categories (in centimeters): 0-15, 16-30, 31-45, 46-60, >60. As with the littoral zone substrate composition for very small sites, it is permissible to estimate the water depth at one meter visually, and then to record your estimates as percent values for each size category (make sure the total of all depth categories equals 100%).

Shoreline terrestrial substrate composition: At each of the littoral zone transects, also record the dominant substrate along an imaginary line starting at the lake shore (or the top of the “bath tub ring” if the lake’s water level is below full pool) and running for **1.5 meters** (5 feet) perpendicular and away from the lake shoreline. The substrate categories are silt-64mm, 65-256mm, bedrock, grass/sedge/forbe, and woody debris. As with the littoral zone substrate composition for very small sites, it is permissible to estimate the terrestrial substrate composition by size category visually, and then to record your estimates as percent values for each size category (make sure the total of all substrate categories equals 100%). Note: brush = willows and other woody plants; forbs = non-woody plants.

Percentage Method: if you are able to stand in one spot and view the entire lake shore, substrate, etc. you may estimate the above categories using percentages of the entire lake, rather than the transect method. This can save time on small water bodies. Make sure the percentage check box is checked on your datasheet or palm and that the numbers for one category add up to 100%.

Tributary Characteristics

Each significant tributary to the water body should be surveyed for 100 meters (200m for R6 crews) for fish and amphibians. In addition general characteristics of each tributary should be recorded, see below.

Any tributary displayed on a 7.5’ map should generally be surveyed and inlet or outlet information completed. Small rills should be surveyed for amphibians, but not necessarily included as a distinct tributary. Within the continuum of tributary sizes and complexities, field crews will be required to distinguish “significant” tributaries from those which do not warrant full tributary surveys. Keep in mind the primary purpose of tributary information is to assess important habitat for fish and amphibians, but not to be bogged down with intense micro-habitat analysis.

Palm – It is very important that palm users realize there is no inherent method of tracking barrier photo data to a specific tributary. Thus, ALWAYS assign a number for each tributary (i.e Inlet 2, or Outlet 1) even if there is only one tributary. It is important to make sure the same tributary number is listed on the barrier photo subform. Also, tributary numbers must be recorded on lake sketches.

Tributary GPS points: Record a GPS point where each tributary joins the lake. Also record a GPS point at the end of your tributary survey. This will help to match inlet/outlet data to the correct tributary.

Tributary number: Record number assigned for each tributary (i.e. Inlet 1, Inlet 2, or Outlet 1). This same number is to be recorded on lake sketch and included in barrier information, so that the correct barrier can be associated with the correct tributary.

Width and depth of inlets & outlets: While walking the lake perimeter, record the average width and depth at bank full of each tributary, even if dry. Inlets generally are widest at the point at which they enter the lake, so obtain the average width and depth upstream of this point. If there are no inlets, circle "no inlets". If inlet is dry enter "Dry" and continue to survey for barriers and amphibians. If there are no outlets, circle "no outlets". If outlet is dry enter "Dry" and continue to survey for barriers and amphibians.
Palm – if there are no inlets check "Inlets NOT Present". If there are no outlets check "Outlets NOT Present".

Presence of fish in inlets and outlets: Record whether there are fish present in the first 100 m (200m for R6 crews) of each inlet and outlet stream by circling "Y" or "N" for each feature. If the stream habitat in a particular inlet or outlet is such that seeing fish would be difficult and you don't see any fish, circle "?". If there are no inlets or outlets, leave this section blank. If inlets and outlets are dry, fish may be present in isolated pools and this is data that needs to be captured.

Distance to first barrier on inlets and outlets: Pace off 100 meters (200m for R6 crews) of each tributary, recording the distance from the lake to the first impassable barrier. Dry tributaries should still be surveyed. The barrier location should be recorded as the number of meters from the lake. Barriers are falls >0.75 m high if there is no pool at the base, falls >1.5 m if there is a pool at the base, or steep cascades higher than approximately 1.5 m. Logjams can float during high water, and should generally not be considered barriers. Because fish can often get over remarkable obstacles, be conservative in what you call a barrier. Provide a description of each barrier on page 2 of the data sheet (see <u>Detailed lake and inlet/outlet description</u>, below) or in the barrier description field in the Palm. If there are no barriers write "none". If there are no inlets or outlets, leave this section blank.

Description of fish barrier(s), UTM coordinates, photo number: Provide a GPS UTM coordinate, photo number, and a brief description of each barrier in the spaces provided. If additional space is needed, use page 2 of the data sheet (see <u>Detailed lake and inlet/outlet description</u>, below). Record the photo file number. It is important to read the appropriate protocols for camera setup and file naming information. Make sure your GPS is setup with the proper settings referenced in the appropriate protocol.

Spawning habitat in inlets and outlets: Up to the first barrier of each inlet and outlet or to the end of the survey reach if no barrier exists, make a visual estimate of the amount of the streambed **between the lake and the first barrier** that is suitable trout spawning habitat. The amount of spawning habitat should be recorded in terms of the <u>number of square meters</u> of stream bottom with the following characteristics: gravel 0.5-4 cm in diameter and not cemented into the streambed, water depths of 10-50 cm, and water velocities of 20-60 cm/s for successful spawning.

Spawning habitat data is used to estimate whether fish populations are self-sustaining. Use good calibration techniques and real measurements as necessary to assure accuracy.

Evidence of spawning in inlets and outlets: Check each inlet and outlet for evidence of spawning **between the lake and the first barrier**, if a barrier is present. This could be spawning trout, redds (nests), or newly-hatched fry (20-30 mm). Redds are often very obvious, being patches of freshly cleaned gravel 0.5-1 m in length. If you aren't sure if what you are seeing is in fact a redd, dig into the downstream portion of the disturbed gravel while holding a net downstream. If it is a redd, you should find eggs in the net after disturbing the gravel. For each inlet and outlet, circle all types of evidence that you find. If you don't find any evidence of spawning, circle "None".

Area of in-lake spawning habitat: Estimate the amount of suitable spawning habitat (using the spawning habitat criteria given above) in the lake at the mouth of each inlet and outlet. Look for the presence of spawning trout and completed redds.

Description of other in-lake spawning habitat: Restrict your description of "other in-lake spawning habitat" to areas where you observe spawning fish, redds, or large numbers of fry in areas of the lake away from inlets and outlets.

Fairy Shrimp

During the amphibian survey, be on the look out for schools of fairy shrimp. The distribution of these 2-3 cm crustaceans is poorly known for the Sierra Nevada, so we are interested in describing localities. Look for them in all bodies of water you sample. When walking around a lake, take a few minutes to also look in small pools and ponds adjacent to the lake.

If you find fairy shrimp either in your samples or during the survey of lake characteristics, indicate this on the data sheet by circling "Y" or "N" to the questions about fairy shrimp locations ("Present in lake?", "In lake-associated pools?", "Other locations?"). "Lake associated pools" are pools within 2 m of the lake. Be specific in your location descriptions, and provide a brief description of these locations (e.g., "1 m^2 pool 0.5 m from lakeshore on N side of lake 70675, pool is 10 cm deep"). Information on the fairy shrimp populations should include, at a minimum, location, surface area, and depth of the habitats.

Palm – If fairy shrimp are not found, be sure to check “Fairy Shrimp NOT Present”. If found, uncheck box and fill out a fairy shrimp subform.

For all habitats that contain mature fairy shrimp (1.5-3 cm long, females carrying eggs) and are separated by ≥1 km from other fairy shrimp samples in the same drainage, collect approximately 10 adults, being sure to collect at mostly large non-egg bearing individuals (look for tusks, these are likely to be males, and males are needed to key these animals out to species). Preserve the fairy shrimp in a 20 ml vial using 95% ethanol. Make an internal label out of a page from your notebook. The label should contain the date, the Site ID, and the drainage name (in pencil). To simplify the process of determining whether a population is ≥1 km away from the last fairy shrimp population from which a collection was made, on the topographic map write “(F)” next to the Site ID from which fairy shrimp collections were made.

Amphibian/reptile surveying

Introduction: We will be conducting amphibian and reptile surveys at all bodies of water shown on 7.5' topographic maps, streams, and at sites not shown on the map but found during surveys and while traveling between sites.

To conduct an amphibian survey, walk **slowly** around the perimeter of the site, or along the stream, counting the number of adults, sub-adults, metamorphs, larvae, and egg masses you find of each species. Pause often to look ahead for basking animals. Use your dip net to sweep habitat and banks in an effort to spook animals. When surveying a lake, VES all inlets and outlets (see above) and lump with the lake VES data. Meadow/marsh sites should be surveyed systematically with multiple surveyors in an effort to survey the entire site. As needed, use the sterilized D-net or aquarium net to catch amphibians and reptiles for identification. Consult the field guide provided for adult and larval identification.

Record total numbers of individuals observed by species and life stage in the appropriate field. If no animals are seen during the VES, record “none” in the field. Species abbreviations are given on the data sheet. Palm- use the pick lists for species abbreviations. If no animals are seen make sure that the “Amphibians NOT Present” checkbox is checked on the amphibian header subform and do not fill out an amphibian data subform.

Under "Comments", record any interesting observations made during the survey (e.g., mountain yellow-legged frog larvae found only in shallow lagoon on NW side of lake). Also record locations of interesting observations on the map of the lake that you draw (see below). If you are surveying inlets or outlets of a lake and encounter amphibian species, record your observations on a separate line on the data sheet and note the approximate locations and species on the inlet and/or outlet diagrams on page two. Palm – use the comment field in amphibian header to note interesting or important observations, or the numbers of animals seen in inlets/outlets, or numbers of multi-age class tads observed.

Time of day, temperature, and weather are important factors affecting the quality of any VES survey. Time your surveys to be during the warm portions of the day (roughly 9am – 6pm, however time window can vary depending upon time of year and local conditions). If the weather is too cold or stormy, VES surveys can be very inaccurate and should not be conducted.

Amphibian/reptile observers: Record the names of all people looking for herpetofauna.

Survey start time and end time: Record the time at which the survey began and ended. The start time is the time the amphibian survey began, not the time you arrived at the site. The end time is the time you finished the VES. Record time as 24 hr time.

Total survey duration: Record the total time spent searching for amphibians/reptiles. Do not include time spent surmounting lake-side obstacles (e.g., cliffs), identifying specimens, or recording notes. If two people survey the same site by walking in opposite directions around the lake perimeter, the total survey duration should include the time spent surveying by each person. This data tells how much effort went into the survey.

Weather/wind/color/turbidity: Circle the appropriate descriptor for each.

Stream survey: Using the GPS unit, record the UTM locations at the beginning and end of your stream survey.

Stream order: Stream order is a classification based on branching of streams. On a map showing all intermittent and permanent streams, the smallest unbranched tributaries are designated order 1. Where two first order streams meet, a second order stream is formed. Where two second order streams meet, a third order stream is formed (and so on…). Using your 7.5' topo map, identify which order of stream you are surveying, and record it in the box provided.

Calling?: Were any frogs calling during your survey? Circle yes or no.

Voucher specimens/tissue samples: Will be collected from populations of mountain yellow-legged frogs. Note that this is done on a population basis and not for each site. Use best judgment in determining the parameters of the population. Up to 20 disease swabs from different individuals, usually adults, will be taken at the sites that support each population.

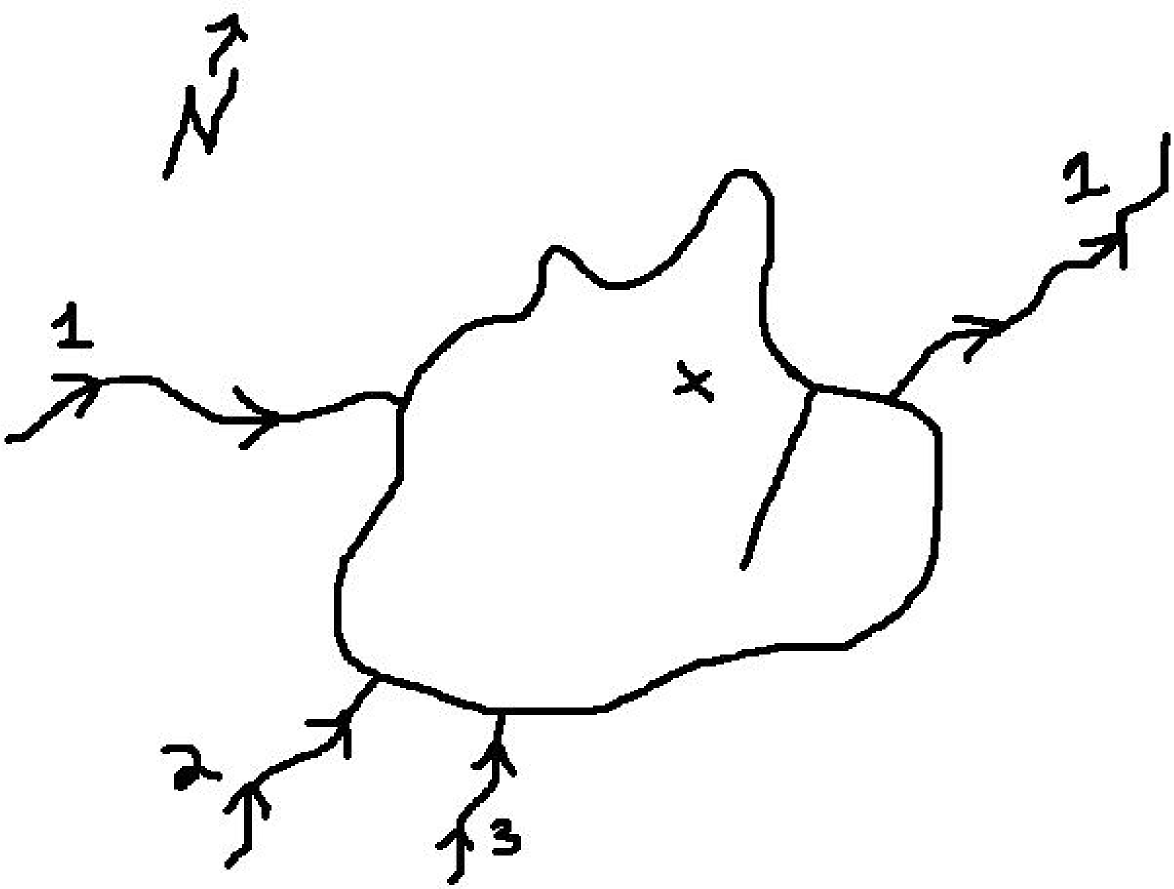
Survey Method: Circle the method used. Note: Mountain yellow-legged frogs do not have a significant call, so aural surveys will not apply.

Air and Water Temperatures: Measure the air temperature from the lake shore at 1 meter above the lake surface. Measure water temperature approximately 0.5m out from shore and 10cm under the water surface. When possible, temperatures should be measured during midday (1100 – 1500). Record the time that temperatures were measured after the @ symbol and the temperature units (C or F).

Detailed Lake and Inlet/Outlet Sketches

Drawing of lake perimeter, inlets, outlets and areas of special interest: Draw the lake perimeter as best you can, use the shape on the 7.5' map if necessary. The most important information that should be included on the sketch is the inlet and outlet locations and corresponding tributary number, max depth location, net set location, North arrow (see symbology below). If there is room, note any important Mountain yellow-legged frog habitat features, such as egg mass or larvae clusters. Add a second sketch if needed. The Palms do not have a lot of room for clutter on the sketch, so keep sketches simple and not cluttered with unnecessary information such as locations of trees, boulders, small islands, good cliff jumping locations, snow fields or talus fields.

Sketch symbology: North arrow = an N with a little arrow at the top; max depth = X ; net set location = a line from the shore; Inlets and Outlets should have tributary number and can be simplified to In1 or In2 for inlets and O1 or O2 for outlets. Also include arrows <<< for directional flow (i.e. either towards or away from lake). See example below:



Description of inlets/outlets: Provide a detailed description of the physical characteristics of inlets, outlets, and barriers. For example, are inlets and outlets very steep cascades or meandering streams? How high are the barriers? Are they falls or cascades? If fish were present in inlets, were they found only below any barriers, or were they also found above the barriers? Note locations of any amphibians observed. Provide a similar description for the outlets.

Overview Photos

Introduction: All surveyed sites should have an overview photo taken. Try to find a location that allows you to capture the entire site and the habitat provided by that site. Thus a lake overview photo should capture the entire lake as well as the shoreline and any inlet or outlet marsh complexes that may be present. Use the panoramic photo functionality of the camera as needed and note how many photos were taken (Palm - in photo comments).

Often forests or flat terrain inhibit good overview photos. In these cases, do the best you can.

Photo Device: Record the device number of the camera – generally the serial number

Photo Type: Choose from the selection the reason or subject of the photo. If a panoramic photo was taken be sure to specify that in the photo type field.

Photo Numbers: Record photo file number. See Appendix for camera setup and additional file naming information.

Photo Times: The times are used to reference a photo to a particular site. It is important to record these times accurately and to ensure that both the camera and Palm date and times are properly set up.

Fish Surveying

Introduction: We will be conducting fish surveys at all bodies of water shown on 7.5' topographic maps and at sites not shown on the map but found during surveys and while traveling between sites.

Our fish survey methods are designed to provide an accurate representation of fish species composition and size structure in lakes and ponds, as well as provide an estimate of catch per unit effort (CPUE) at each location. In order to quantify the size structure of each fish species present at a particular location, we need a sample of at least 20 fish, and preferably not more than 50. Obviously, in lakes that have a very small fish population, capturing even 10 fish may not be possible.

We will set one net in each lake for 8-12 hours. Nets can be set at any time of day. To minimize logistical problems and safety hazards, do not pull nets at night. Time your net sets appropriately. For example, don't set a net at 5 PM, since this would mean either pulling the net at 1-5 AM or waiting until morning and exceeding the 12 hour maximum set duration. You should plan on setting nets in the late evening or early morning.

If you are setting a net in a lake with an extremely dense trout population (typically lakes with brook trout), you may want to paddle over the net with a float tube after 4 hours and get a rough count of the number of fish captured. If you have 40 or more fish after 4 hours, pull the net to avoid capturing an inordinate number of specimens. Use this 4 hour net set duration only when absolutely necessary. If gill-netting a lake that contains amphibians, you need not worry that the net will trap them. If turtles are present, set the gill nets during the day only and check the nets frequently to ensure that these species are not getting entangled.

Before setting a gill net, submerge the entire net (still contained on the handle); dry nets are much more susceptible to tangling. To set the net, put a small rock into each of two mesh bags and clip one bag to the shore end of the net (end with loop). Get in your float tube and wedge the bag between rocks at the lake shore and pull on it gently to ensure that it is firmly anchored. With the net lying across the float tube (lead-line on your left and net handle in your right hand or vice versa), paddle backwards slowly while feeding out the net. The net should be set perpendicular to the shore. If you encounter a tangle while feeding out the net, shake the net. Do not pull on the net as this will often tighten the tangle. Shaking will nearly always rid the net of the tangle. When you get to the end of the net, attach a float to the handle and then clip the second bag to the bottom of the net. Paddle backwards until the net is taught, and then drop the bag. Record the time when you finish setting the net.

After 8-12 hours, retrieve the net by pulling the mid-lake end of the net up by the float. Detach the float and the bag. Pull the net toward you, placing the float line on one side of the float tube and the lead line on the other. Continue pulling in the net until you reach the shore. Remove the second bag. To carry the net to an area for fish removal, cradle the net over your arms keeping the lead line on one side and the float line on the other. Lay the net down in a meadow or on a sandy flat (a meadow is preferable, but nearly any place will work; stay away from areas with lots of woody vegetation, pine needles, pine cones, and sharp rocks since they will get snagged in the net). Spread out the first 10 feet of net and remove the fish. After removing all fish from the first 10 feet of net, spread the next 10 feet of net and fold up the first 10 feet. Continue until you have removed all fish from the net. Restring the net onto the handle, rinse the net in the lake, dry the net in the shade, tie the net in a knot to prevent tangling, and stuff it into a sack. <u>The net may be set again without sterilization if the receiving water is located **downstream** from the previous netting site. If the next netting site is located above the previous site, or in a separate drainage (even a small side drainage within the same basin) then the net must be sterilized (see sterilization protocol).</u>

Fish survey method: If fish are observed, generally set a net. Record whether fish were surveyed visually or using gill nets. Except for small, shallow (<2 m) bodies of water in which the surveyor can see the entire lake bottom, we typically sample fish populations using gill nets. If there is any question as to whether fish are present in a lake, set a net. The only other exception is lakes/ponds where populations of yellow-legged frogs are present. The decision whether to set a gill net in a shallow pond is up to the crew leader, but keep in mind that fish can live in some very marginal habitats. If only a visual fish survey is needed (e.g., because the lake is < 2 m deep and you can see the entire bottom and there is positively no fish, or because there is a healthy population of frogs), you need not fill out the third and fourth pages of the datasheet. (For Palms this is the “Fish Subform.)

Visual Survey Justification: If you surveyed for fishes visually, provide a brief justification as to why you chose this method (e.g., "pond only 50 cm deep, entire bottom visible, no fish seen or frog population present"). Remember, if fish are seen you should almost always set a net.

Net set time and date: Record the time when you completed the net setting process, not the time when you started setting the net. Record the time as 24 hr time. Record the date on which the net was set.

Net pull time and date: Record the time when you began pulling the net. Record the date on which the net was pulled.

Site ID: If you are setting a gill net to survey a fish population, fill out pages 3 and 4 of the datasheet. First, record the Site ID again. This identifier will ensure that both sheets of the datasheet are associated with the correct lake. Make sure that the Site ID you record is the correct one and matches the Site ID on the first page of the datasheet.

Water temperature: Measure water temperature approximately 0.5 m out from shore and 10 cm under the water surface. Record temperature in Celsius. Temperature should be measured during midday (1100-1500) when possible.

Description of net location/setting nets: Circle the appropriate location and provide a brief description of the area in which the net was set ("Comments"). Gill nets should always be set at the lake outlet, if present and if conditions allow. If an outlet does not exist, or is located in an area that is difficult to net (water <2 m deep, log jams, etc.), set nets at the inlet. If an inlet is not present or is not suitable, set the net in a suitable location anywhere along the lake shore. If possible, choose an area that is 3-8 m deep.

Fish Data: If no fish were captured, write "no fish" across the fish portion of the data sheet. If fish were captured, record the species, length, and weight of all fish. Species abbreviations are given at the bottom of the data sheet. Measure fish using the vinyl tape laid out on the ground. Measure fish total lengths to the nearest mm. Weigh fish using a Pescola spring scale. Before weighing fish, ensure that all debris (small rocks, etc.) are removed from the fish. Use the 60g scale for all fish <100 g, and the 300g scale for larger fish. Outliers may need to weighed in parts.

All fish will need to be cut open to determine sex. If someone on your crew is able, also note the general contents of fish stomachs (e.g., chironomid pupae, terrestrial insects, etc.). If you encounter a lake that contains both fish and amphibians, look through the fish stomachs very carefully for amphibian remains.

Female fish will have eggs ranging from very small (early) to large and flaccid (late, deflated looking). Make a check mark in the appropriate box for each female fish sampled.

Fish age-analysis can be used to determine if a population that has been supported by biennial (or less frequent) stocking is self-sustaining. Otoliths (ear-bones) should be collected from up to twenty of the sampled fish over the range of sizes captured that are less than 200 mm total length, and **only** from lakes where it is difficult to determine whether fish are self-sustaining (young-of-the-year are not visibly present in tributaries or around margins of lake). Do not collect otoliths from brook trout, since the Department no longer stocks them in most waters. Place otoliths from each fish into a separate vial labeled with the Fish #. Label the vial with a fine-tip Sharpie. Keep all vials for a particular lake's otolith sample in a small Ziplock bag with an internal paper label that includes the date, the Site ID, the drainage, and the species of fish.

Be careful about disposing of fish carcasses, as we don't want the carcasses attracting the attention of backpackers or bears. The best disposal method is to pop the fish’s swim-bladders, paddle out into the lake until you reach a relatively deep area, and dump them. Burial of fish on land should generally be avoided, as animals can smell the fish and will dig them up (no matter how deep you bury them).

Net sterilization: When moving to a different drainage or when one site does NOT flow into the next site gear (float tube, waders, fins and gill nets) must be sterilized. Sterilize using 5 ml of Quat 128 per 1.5 gallons of water. Gear must be soaked for at least 20 minutes and the dried for at least 20 minutes. Dispose of Quat 128 on rocks or soil away from waterways. Consider rinsing gear in fresh water away from potential amphibian sites before next use.

Field review of datasheets

At the end of each day, the crew leader should review all datasheets for completeness and clarity. Once review of a datasheet is completed, the crew leader should initialize the field review box on pages 2 and 3 of the datasheets. Make sure all of the spaces on the data sheets have been filled in. These data sheets are all the state has to show for the time and money that went into each survey. Protect the data sheets as if they were your most prized possession!